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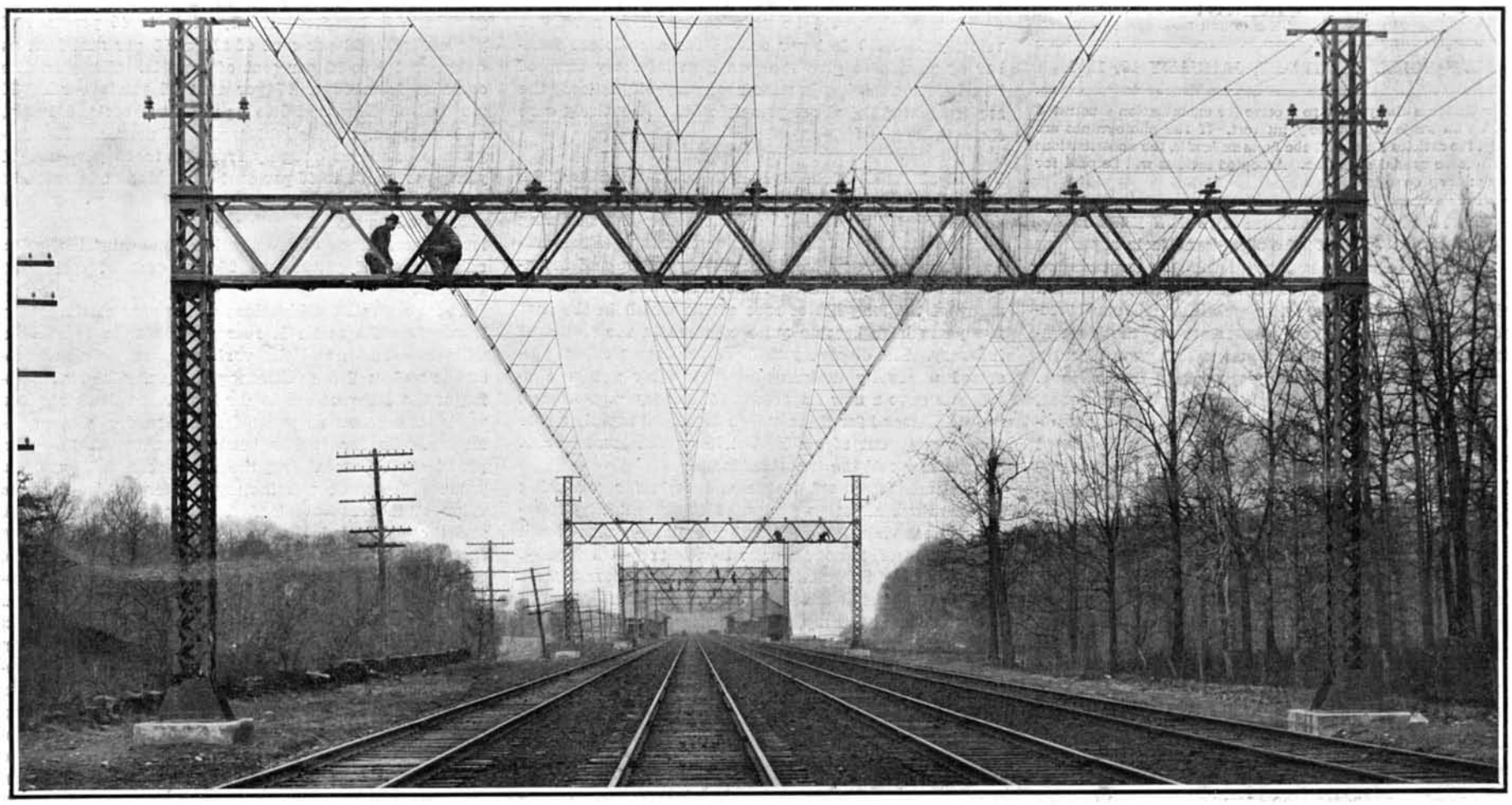

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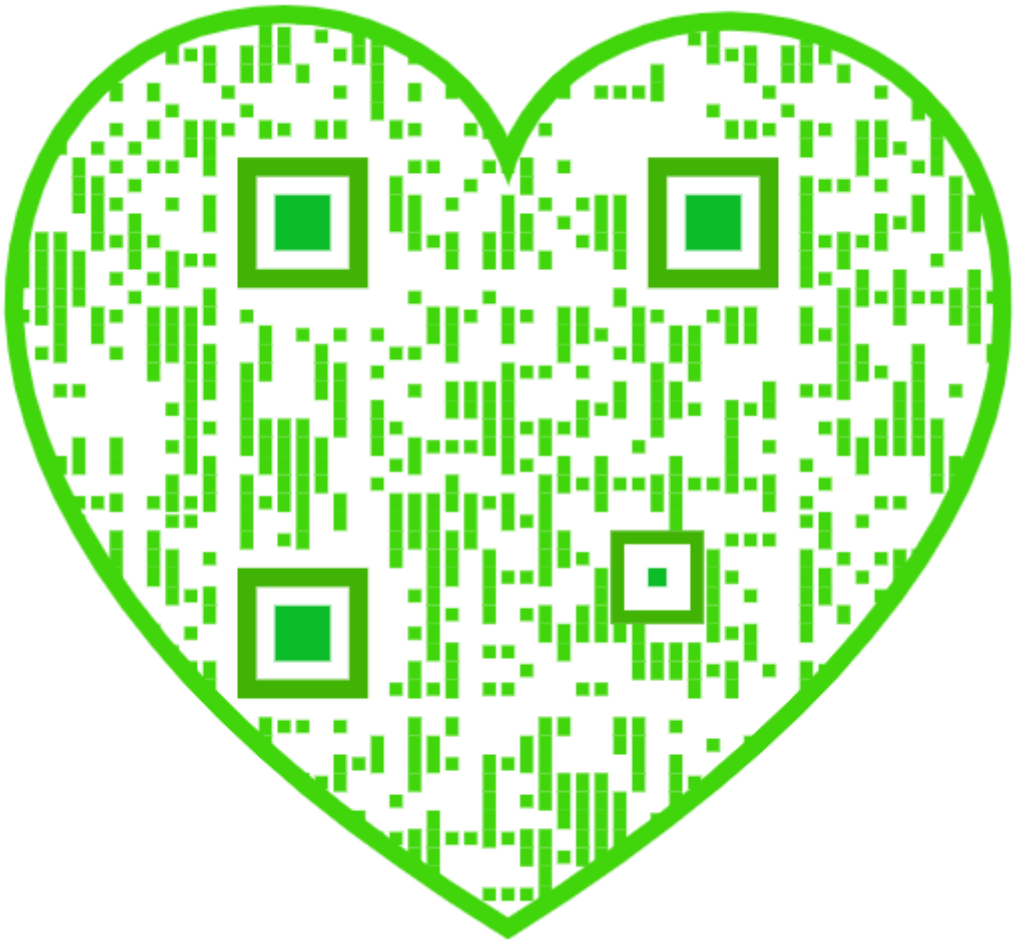
The Trolley Lines of the New York, New Haven & Hartford Railroad.

The locomotive, of 3,200 maximum horse-power, weighs 95 tons and can exert twice the horse-power of the express steam locomotives of the road.

The First Trial Electric Train Starting from the Grand Central Station.

ELECTRIFICATION OF THE NEW YORK CENTRAL AND NEW HAVEN RAILROADS.—[See page 72.]



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NEW YORK, SATURDAY, JANUARY 19, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

LARGE POWDER CHAMBERS AND GUN EROSION.

We direct attention to the significant facts regarding the relation between the size of the powder chamber and the pressures and velocities of guns, to which reference is made in a letter published in our correspondence column. The facts relate to the government tests of the Brown wire gun, which were recently completed at the army proving grounds at Sandy Hook. Simultaneously with these tests, another high-powered, wire-wound gun, designed by Gen. Crozier, was subjected to similar tests. Both of these guns developed powder pressures, velocities, and energies, far in excess of anything officially recorded, as far as we know, for guns of 6-inch caliber, at any of the government or private testing grounds either here or abroad. In both pieces, velocities were run up to a figure hundreds of feet per second greater than the generally accepted maximum service velocity of three thousand feet per second, which is considered to be about the limit for guns of this caliber. As was to be expected, in the case of both guns the high powder pressures developed produced severe erosion. This pressure in the case of the Brown wire gun reached the high limit of 32 tons to the square inch in the powder chamber, with a corresponding muzzle velocity of 3,740 feet per second.

Those of our readers who have followed the current discussion in our columns will remember that we have always considered that erosion was chiefly due to the escape of gases past the projectile, the leakage being due to the failure of the copper rifling bands to properly fill the grooves of the rifling. A strong presumption that this view is correct is offered by the experience gained during the tests of the two high-powered guns above referred to; for under the fierce heat and enormous pressures involved, the scoring was so excessive that, in the last rounds, the projectiles from one of the guns failed to rotate properly, and the shells tumbled end over end. In firing the last ten rounds with the Brown gun, under excessive pressures, the average for these rounds being 55,000 pounds per square inch, and the average velocity over 3,600 feet per second, Mr. Brown, the inventor of the gun, with a view to preventing the escape of the gases and securing a good grip on the already badly worn rifling, provided the shells with rifling bands of much greater size than those used in the earlier rounds. This experiment was highly successful, the projectile making a true flight, and the extraordinarily interesting and valuable fact being developed, that the progress of the erosion in that portion of the gun not already seriously affected, was practically stopped, the star gaging records of the government report showing that there was practically no erosion at all in the last fourteen feet of the muzzle end of the gun.

"One swallow does not make a summer"; but here, surely, is a fact which should give food for careful thought and prolonged investigation before gun erosion is placed among the class of incurable diseases.

To the ordnance expert, however, the chief interest will be found not so much in the last ten rounds at high pressures, as in the earlier rounds fired with lower pressures and more moderate velocities. For in these rounds the surprising fact was developed (although, strange to say, it seems to have been entirely overlooked) that in guns like those of the Crozier and Brown type, provided with unusually large powder chambers and charges, it is possible to secure high velocities with very moderate pressures, 2,879 foot seconds being obtained with only 28,475 pounds pressure, in the Brown gun, and, in the Crozier gun, 2,938 foot seconds with the very moderate pressure of 30,810 pounds to the inch. Now these velocities are considerably higher, and the corresponding energies greater, than those of the government 6-inch guns either in the army or navy, the latter 50-caliber piece having a service velocity of 2,700 to 2,800 foot seconds with pressures of not less than 18 tons to the inch, while the service velocity of the army 6-inch guns is to be lowered, we believe, to 2,600 feet per second, with a view to reducing powder pressures and so prolonging their life.

In view of the promising results obtained in the earlier rounds of these guns, we would suggest to the artillerists that the solution of the problem of erosion may, after all, be found in the direction of large powder chambers and greater length of gun, combined with a high average pressure along the bore and low maximum pressure in the powder chamber. It is our belief that a 55-caliber, 6-inch gun, using a heavy charge of slow-burning powder specially designed for it, in a powder chamber of capacity equal to those of the Crozier and Brown guns, and with its projectiles double-banded, would be able to maintain a service velocity of 3,000 feet per second for a sufficient number of rounds to give the gun a satisfactory term of life, before re-lining became necessary—if, indeed, the application of the above principle did not entirely cure the evil.

VALUE OF RARE EARTHS FOR ELECTRICAL PURPOSES.

In the improvements of electrical illuminants the demand for rare earths has greatly stimulated mining for them in different parts of the country. When carbon was employed almost exclusively in arc and incandescent lamps practically little value was attached to many of the long list of rare earths which in the past few years have become quite common in the electrical industry. The discovery that the rare earth oxides possessed unusually desirable properties for use as illuminants gave a new impetus to laboratory experiments, and the demand for these oxides increased rapidly under the development of the Nernst lamp, the incandescent gas mantles and the tantalum lamp.

Welsbach first used thoria and ceria for producing gas mantles, and this suggested the possibility of securing materials for electrical illuminants that would prove equal to, if not superior to, the carbon filaments. While carbon is practically infusible, it nevertheless slowly vaporizes at the high temperature maintained in the incandescent lamp, so that after being used from 400 to 600 hours it is necessary to renew it.

In tests with the rare earths it was found that they were more fusible than carbon, but their vaporizing properties were in some cases much less pronounced. It is this slower vaporizing quality of the rare earth oxides that makes the Welsbach mantle and the Nernst lamp possible. Connected with this quality of slow vaporizing at high temperature is the equally important one that many of the oxides conducted electricity at ordinary temperatures. Others only conducted electricity at very high temperatures, but were found to be very refractory. By mixing several different kinds of the oxides and baking them in the form of filaments a higher fusing point was obtained and greater electrical conductivity. The possible combinations of these oxides open a wide field for future experiment.

Thus, in the Nernst lamp a combination of 85 per cent zirconium oxide and 15 per cent of yttria earths is used; but yttria itself is a mixture of several oxides found in certain minerals. The early gas mantles were composed largely of zirconia, but these have been improved by combining other rare earths to increase the refractory nature of the glowers. The improvements are due entirely to a study and a long series of experiments with the different earths.

The value of a commercial glower depends upon its efficiency and its ability to operate at a high temperature for a considerable length of time. Thus, the Nernst glowers operate at a temperature of about 2,300 deg. C., and at about twice the efficiency of a carbon incandescent lamp. The ordinary life of these glowers averages 800 hours when the depreciation of the candle-power is sufficient to destroy its usefulness. Both the Nernst and carbon incandescent lamps have their period of usefulness rated by the number of hours required to decrease the candle-power by 20 per cent of the initial light. Similarly the value of the tantalum filament of the tantalum lamp is dependent upon the relative time required to depreciate its conductive and glower properties when used under high temperatures.

The experiments with the rare earths to secure higher illuminating efficiency are further emphasized by the difference in the quality of the oxides obtained from various parts of the world. Until comparatively recently most of the rare earths for electrical purposes were obtained from Europe, but deposits have been found in this country which possess superior qualities to those imported. Some of the best zirconium silicate is mined in Henderson County, North Carolina, and deposits have been discovered in other States within the past few years. The North Carolina deposit contains upward of 67 per cent of zirconium as oxide. It is found in a ball mill mixed with about twice its weight of crude acid potassium fluoride. The recovery of the ore by fusing in a graphite crucible and dissolving it in chemicals is not a very intricate or costly process. The zirconium thus obtained is reasonably pure. Test glowers from hundreds of lots of zirconia demonstrate that the best oxides can be obtained and purified from the American mines. Absolutely pure zirconia is not demanded, and the slight traces of silica left in the American product tend to improve the efficiency of the lamps.

In Llano County, Texas, considerable quantities of gadolinite in crystalline form associated with yttrialite, crytolite, fergusonite, rowlanite, allanite, and other minerals are found. Not many years ago the minerals gadolinite and yttrialite were obtained entirely from Norway and Sweden, and their cost made even laboratory practice with them rather expensive. The deposits in Texas are supposed to be of volcanic origin, and they are radio-active and contain a certain amount of helium gas.

Tests of these products in Texas show that the gadolinite is composed chiefly of 40 to 45 per cent of yttria earths, 23 per cent of silica, 13 per cent iron as oxide, and 9 to 12 per cent of beryllia. The yttrialite contains from 42 to 47 per cent of yttria earths, 30 per cent of silica, and 5 to 6 per cent of ceria, didymia, and lantham, with slight traces of urania. The fergusonite contains roughly from 30 to 42 per cent of yttria earths, 33 to 46 per cent of niobia; and rowlanite from 46 to 62 per cent yttria earths, 26 per cent of silica, and traces of iron and magnesia. Allanite has large percentages of iron, calcia, and alumina, with only traces of yttria and 26 per cent of ceria and didymia.

These natural combinations of the rare earths in the Texas deposits make it reasonably simple to recover what is desired, and the various ingredients are separated and used for different purposes. The recombining of the different earths for illuminant filaments is a work that possesses great fascination for the experimenter. So far it has been demonstrated that the yttria earths containing the greatest atomic weights produce the most satisfactory glowers. The relative value of the ores obtained from Norway and Sweden and those mined in Texas can be judged by the fact that the former has as low as 90 to 92 atomic weight compared to 115 for the Texas yttrialite, 107 for rowlanite, 103 for the fergusonite, and 100 for gadolinite.

The question of the actual amount of these deposits in this country is one that has not yet been definitely settled. Reports of equally valuable deposits in Colorado and other Western States have been made, but whether the quality of the rare earths is as good as those found in Texas is open to doubt. The actual demand for the ores has not in the past been sufficient to make them of great commercial value, but with their extensive use in electrical illumination important new industries promise to be built up. So long as their use was confined chiefly to laboratory practice and experiment there was little chance of their commercial development on a large scale.

The manipulation of the different oxides to secure better results suggests great possibilities in the field of experiment. The remarkable development of tantalum metal in the past few years is an indication of the advances made along this line. Until a few years ago tantalum metal was not known to possess the properties which make it of such service in electric illuminants. In some of the laboratories experimental lamps have been made with electrodes composed entirely of the rare earth oxides. From these experiments new filaments may be devised in time which will greatly increase the efficiency of the lamps and prolong their days of usefulness without renewals. In arc lighting the introduction of boron and tantalum in different proportions and forms is being pursued with tireless energy. In Europe the experiments with rare earths in electric arcs have been more energetically pursued than in this country, but with the discovery of new and rich deposits of these materials in this country it is not unlikely that considerable experimental work will be carried on in private laboratories and manufacturing shops. There is unquestionably a great future for further important developments in electric illumination in this direction.

PERHYDRASE MILK—A NEW STERILIZED MILK.

The problem of freeing milk from germs and yet retaining all its nourishing properties has probably been solved by Drs. Roemer and Much, both of whom have been associated with Prof. Behring in his bacteriological work. The process consists in the use of peroxide of hydrogen under conditions which kill the germs. To each liter of milk is added two to four drops of a ferment obtained from beef liver from which the blood has been expressed. This ferment, which contains minute particles of albumen, destroys the unpleasant taste given to the milk by the peroxide of hydrogen. To the forty grammes of albumen contained in one liter of milk under normal conditions there are, therefore, added minute quantities of homologous albumen.

"Perhydrase milk," as it is called, does not materially differ from raw milk. It can, however, be kept for a long period without deteriorating. Samples of the milk which were placed in an incubator for seven weeks remained sterile. Experiments made by mixing

cow milk containing tubercle bacilli with perhydrase milk proved that the latter destroyed the tubercle bacilli. In contrast to heat sterilization, the amount of albumen remains unchanged. This was ascertained chemically, and by means of the addition of tetanus antitoxin. The renneting power does not change. Peroxide of hydrogen cannot be determined in the milk one-half hour after the addition of peroxydase. With paraphenylendiamine the reaction does not take place immediately, as in the case of raw milk, but only after four to seven hours. To the taste perhydrase milk does not differ from raw milk. The cost of the milk is increased four to five cents per liter. Perhydrase milk must be kept in a dark place. Exposure to light will give it a bitter taste, but there will be no appearance of germs. As the German law prohibits any addition whatever to milk, a general introduction of the method cannot now be made. At present its use is confined to agricultural practice.

RECENT PERFORMANCES OF THE FRENCH AIRSHIP "PATRIE."

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The new airship "Patrie," which was built for the French government on the same general plan as the "Lebaudy," and which we have already described, finished the series of military experiments which went on for some time in the region of Paris by a brilliant performance and one which speaks most favorably for this airship in particular as well as showing what can now be accomplished. On the 15th of December, having made all the trial flights around the balloon shed which were required, the airship started to its destination, the military aeronautic grounds of Chalais-Meudon, near Paris, and reached this point after a very good flight in a straight line of 52 kilometers. It started on the trip at 10 o'clock in the morning and attained high speed, seeing that it reached the aeronautic establishment at 11:12 A. M. The flight was made under the orders of the chief of the Etat-Major, and it was remarkable to see an airship start off at command and arrive without difficulty at a distant point and one which was difficult to light upon on account of the obstacles which surrounded it. We give a few details as to the flight, which is without doubt the most remarkable of the year for an airship. It was brought out of the balloon shed at 9:30 A. M. and then taken to the flat ground, where the preparations for the start were made exclusively under the direction of the army officers and the military aerostatic corps. In the car were Capt. Voyer, the pilot on this occasion, Lieut. Bois, aid, also the mechanics Duguffroy and Rey. At 10 o'clock the airship started up and commenced the flight toward Meudon. Well guided by the pilot, in spite of a rather stiff breeze of 45 feet per second which blew against the side of the balloon, it proceeded in a straight line toward its destination, being very well balanced in the air and keeping at about 656 feet altitude. Passing over the neighboring town of Mantes, then coming above Maule and Versailles, it finally reached Chalais-Meudon, where part of the corps of military aeronauts which had been stationed for some weeks at the establishment, was waiting for its arrival, under the orders of Commandant Boutheaux. Soon the long cigar-shaped balloon was seen above the woods which surround the Chalais balloon shed. It made a half-turn so as to bring the front against the wind, then headed for the point where the group of aeronauts was waiting, and they brought it down to the ground by hauling upon the cords. The landing took place at 11:12 and the 31.4 miles in a straight line had been made in 1h. 12m., which makes a speed of about 28 miles an hour. But the real speed must have been more than this, because the airship had to slow up for several minutes while making the evolutions before the landing. For the present, the "Patrie" will be housed in the Meudon balloon shed, while waiting for it to be transferred to the fortified post of Verdun, where the army corps is preparing a model balloon ground especially for it. It is thought that in the meantime it may make a trip to Paris, as the "Lebaudy" formerly did with such success. It will be remembered that the third balloon of the series, the "Republique," is to be built next year, and there is some talk of constructing a fourth airship the year following, which will be known as the "Democratie."

Quite a sensation was awakened in Paris by the flight which the great airship "Patrie" made above the city at a great height on the 17th of December. Soon after the arrival of the airship at the Chalais-Meudon grounds in the suburbs of town it was decided to give the Parisians an opportunity to see the new airship, and therefore it made the trip in spite of the somewhat foggy weather which prevailed that day. Preparations for the flight commenced at the Chalais grounds at 2:30 in the afternoon, and at 3 o'clock the airship left the establishment and directed its course for Paris, running against a rather strong northeast wind. Capt. Voyer piloted, and with him were Capt. Gaucher, another officer, and two mechanics. Soon the balloon disappeared in the fog, but upon reaching the city it re-appeared, and could easily be seen sailing along at what appeared to be a slow speed, but was in reality a good rate. Somewhat after three o'clock it was seen flying above the Grand Palais, where the crowds assembled on the occasion of the automobile show could observe it very well, and were much impressed with its appearance and the ease with which it made the evolutions in the air. The airship ran at a good speed keeping at a height of about 1,000 feet, and passed above the different government buildings such as the president's residence, the Chamber of Deputies and the War Department. Not more than three-quarters of an hour was needed for the whole trip, and the airship continued to keep about the same height, giving signals from a siren which were heard on the ground. Before four o'clock it had regained the military headquarters, where it came down and was put in the shed with the usual maneuvers with which the military aerostatic corps are now quite familiar. As usual, the airship distinguished itself for its remarkable stability in the air, which is one of its chief characteristics and speaks well for Engineer Julliot's design. A very good speed was also made and the airship was handled with ease.

FACTS ABOUT BLACK LEAD PENCILS.

BY KATHERINE B. CALHOUN.

It is difficult to determine the exact period in which "black lead" was first utilized as an instrument for writing or drawing, as it has been confused with other mineral bodies to which it bears no relation. The ancients used lead, but the metal was formed into flat plates, and the edges of these plates used to make the mark. If an ornamental design was desired, the transcriber drew parallel lines, and traced their illuminated designs, usually with a hard point but also with soft lead. That lead was known to the ancients is also proven by the fact that it is mentioned in the Book of Job.

During the year 1615 there was a description of the black lead pencil written by Conrad Gesner. He says that pieces of plumbago were fastened in a wooden handle and a mixture of fossil substance, sometimes covered with wood, was used for writing and drawing. About half a century later a very good account of this mineral was given, and it was then used in Italy for drawing and mixed with clay for manufacturing crucibles. We are informed in Beckman's "History of Inventions" that the pencils first used in Italy for drawing were composed of a mixture of lead and tin, nothing more than pewter. This pencil was called a stile. Michael Angelo mentions this stile, and in fact it seems that such pencils were long used in common over the whole continent of Europe. At this period the name plumbago or graphite was not in use, but instead the name molybdena or molybdoids, which is now applied to an entirely different mineral.

Graphite or black lead is formed in the primary rocks. In the United States it occurs in felspar and quartz, in Great Britain in greenstone rock and gneiss, and in Norway in quartz. The mine at Borrowdale, England, has supplied some of the finest black lead in the world, but the quantity varies, owing to the irregularity with which the mineral occurs.

The Jews were for a while the only manufacturers of pencils. It required great skill to perfect the manufacture, according to the degree of hardness or softness required. Of recent years the manufacture of pencils has increased to such an extent that the price of these articles has decreased proportionately. Graphite and pure clay are combined and used in the manufacture of artificial black lead pencils, and on the other hand the greatest perfection is attained in the making of the higher class pencils. Graphite is exposed to heat to acquire firmness and brilliancy of color. Sulphur is also used to secure a more perfect color.

THE YAWNING CURE FOR THROAT DISEASES.

A little book, recently published in Vienna, is devoted to a method of vocal culture, and also health culture, that has stood the test of practical experience in numerous cases but is not as well known as it deserves to be. It is based upon the vocal method of the concert singer Josephine Richter, the mother of the celebrated orchestra leader, Hans Richter, and consists essentially of peculiar movements of the jaws which ultimately give the pupil an astonishing command over the soft palate, besides strengthening the muscles of the face, neck and chest.

Herr Lanz, the author of the book, quotes a letter written to Mme. Richter by the late Prof. Helmholtz in which that famous physicist says: "I can readily understand, from theoretical considerations, that the flabbiness of the soft palate and the back of the mouth must act as a damper upon the voice and an obstacle to precision of attack and utterance. Hence if the command of the palate, tongue and larynx which you possess can be acquired by your method of exercising the muscles of the face and throat, as your own example appears to prove, the fact is clearly of great importance. It is physiologically probable that such exercises would have that effect."

That the exercises do have that effect is proved by an examination of an average untrained throat and the throat of a singer trained by the new method. In the former the soft palate and its conical extension, the uvula, hang limp and constrict the vocal passage, which is further narrowed by the prominent tonsil at each side. In a mouth so encumbered, as in a room filled with furniture, it is impossible for the voice to ring loud and clear. The tonsils and soft palate of the trained singer, on the other hand, are retracted and hardened and the pendent uvula has entirely disappeared, giving the voice a clear and wide passage with firm walls, and consequently increasing its volume and improving its quality.

The method is recommended for the cultivation of the speaking as well as the singing voice and for the prevention and alleviation of various diseases of the throat. "It gives astonishing relief in catarrh of the throat and suggests new possibilities in the treatment of enlarged tonsils."

Now these exercises consist essentially of yawning, which has recently been recommended, independently, as a valuable exercise for the respiratory organs. According to Dr. Naegli of the University of Luettich, yawning brings all the respiratory muscles of the chest and throat into action and is therefore the best and most natural means of strengthening them. He advises everybody to yawn as deeply as possible, with arms outstretched, in order to change completely the air in the lungs and stimulate respiration. In many cases he has found the practice to relieve the difficulty in swallowing and disturbance of the sense of hearing that accompany catarrh of the throat. The patient is induced to yawn through suggestion, imitation or a preliminary exercise in deep breathing. Each treatment consists of from six to eight yawns, each followed by the operation of swallowing.

It should be added, however, that it is quite possible for deep breathing to be overdone, particularly by persons with weak hearts, and it is at least open to question whether the obstacles to free respiration which the yawning cure is alleged to remove are not useful in preventing the entrance of germs and other foreign bodies.

CLIMATE: PAST AND PRESENT.

In the Monthly Weather Review, F. M. Bail argues that the popular belief that the climate is changing is not supported by an examination of some of the oldest records available, such as Angot's dates of vintage days since the fourteenth century, and temperature averages at St. Petersburg (since 1743), Philadelphia (since 1758), and St. Paul, Minn. (since 1822). Geology, on the other hand, teaches us that the climates must have changed many times. Mr. Bail discusses the general factors which determine climate, with special reference to the changes in the distribution of land and sea, changes of elevation, to Croll's theory, to T. C. Chamberlin's hypothesis that refrigeration and glacial sparks might be due to a depletion of the atmosphere of carbon dioxide, water vapor, and dust particles, and to the changes in the winds that would result from change in the configurations of the continents.

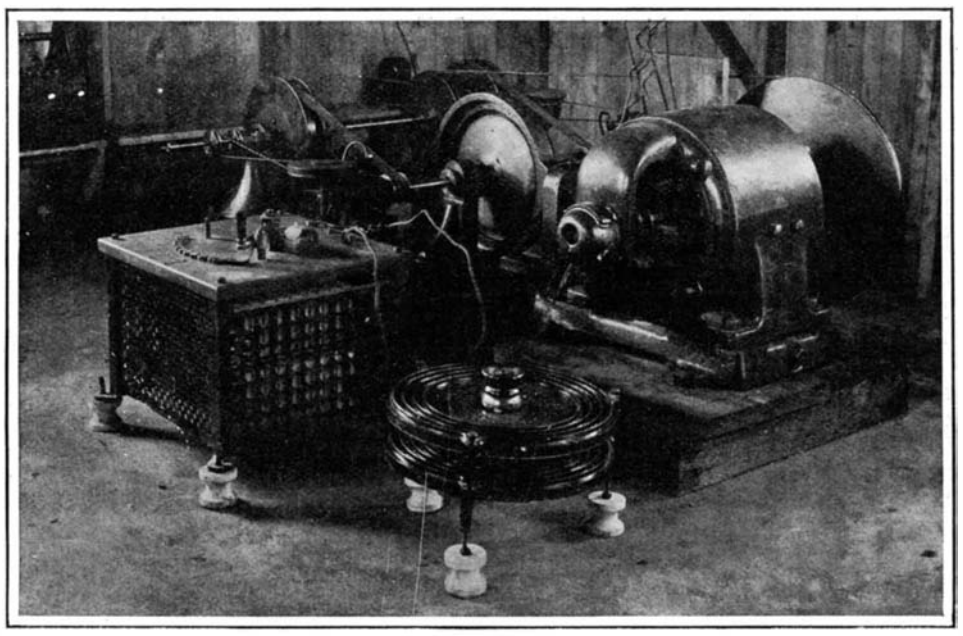
THE CURRENT SUPPLEMENT.

The great Union Station at Washington is nearing completion. Few pieces of work under way in America excite more interest and curiosity than the construction of this vast Roman palace of shining granite. Mr. Frank N. Bauskett writes instructively and eloquently on the subject in the opening article of the current SUPPLEMENT, No. 1620. Mr. E. J. Bolton contributes a well-considered and illuminating explanation of the manufacture of brass wire. Last year Prof. Berthelot published some results of experiments which tend to rehabilitate theories long since abandoned and to furnish a fresh proof that science moves in circles. In an article entitled "Radium and Geological Changes," the results of Berthelot's investigations are imparted. The ability of the modern gas engine to take the place of the steam engine in general power work has been questioned, as well as the ability of the gas engine and producer to work harmoniously together under widely varying load demands. Mr. J. R. Bibbins throws much light on the subject in his article on "A Producer Gas Power Test." Load diagrams, fuel consumption curves, efficiency test charts, and indicator cards accompany the text. Gas engine types are discussed by Jonas E. King. William McDonald writes on reinforced concrete in greenhouse construction. One of the most interesting papers read before the recent meeting of the British Institution of Civil Engineers was that of the president, Sir Alexander B. W. Kennedy, on the "Work of the Engineer." The paper is published in the current SUPPLEMENT The development of battleship protection is simply set forth. E. Walter Maunder, the well-known English astronomer, reviews the progress of astronomy in 1906.

RECENT PROGRESS IN WIRELESS TELEPHONY.

BY REGINALD A. FESSENDEN.

A public demonstration of its latest form of wireless telephone apparatus was given by the National Electric Signaling Company at its Brant Rock and Plymouth stations, approximately eleven miles apart, on December 21. Invitations had been issued to a number of prominent electrical companies and electricians. Among those present were Prof. Elihu Thomson, Mr. Pickard, the well-known wireless and telephone expert, representing the Bell Telephone Company, representatives from the technical press, and others.



Dynamo Giving 80,000 Alternations per Second.

The National Electric Signaling Company transmitted speech wirelessly for the first time in the summer of 1900, by the method disclosed in U. S. patent 706,747. While the speech transmitted could be understood, there was a great deal of extraneous noise in the telephone, and various devices were devised for eliminating this. Among other methods the arc gap method shown in Fig. 1 (see U. S. patent 730,753) was used. This is an improvement on the original Elihu Thomson singing arc method, recently rediscovered by Poulsen and others, but which was used by the National Electric Signaling Company in 1901 and patented in 1902.

The extraneous noise had been sufficiently eliminated by 1904 to render it possible to put the wireless telephone on the market, and the National Electric Signaling Company consequently in that year began to advertise sets guaranteed to transmit speech up to 25 and 100 miles.

Though sufficient for most practical purposes, a certain amount of extraneous noise still remained, but some six months ago this was entirely removed, so as to permit of even faint whispers and the noise of breathing being transmitted. In addition a new telephone relay was invented, which permitted of talking from one local exchange and receiving messages at another local exchange, the message being transmitted over a wireless trunk line, thus enabling passengers, for example, on a steamer to converse with friends at a local exchange on shore.

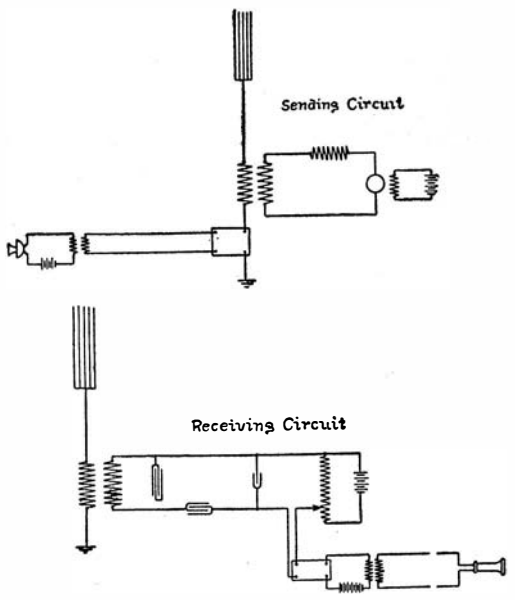


Fig. 3.—Connections for Relay System.

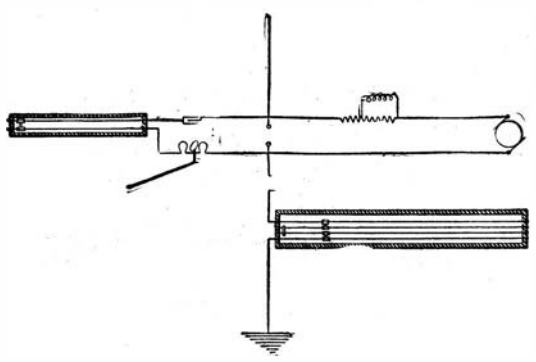
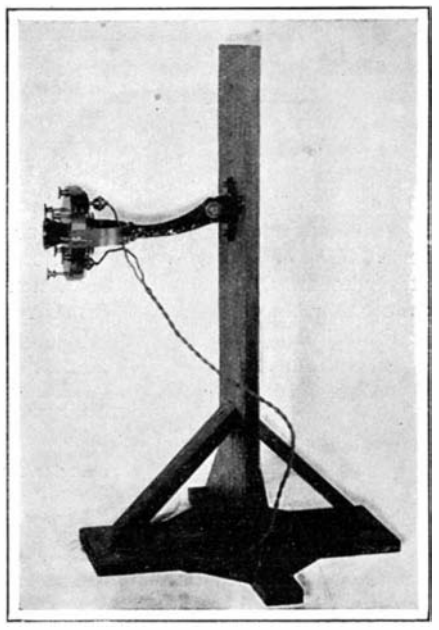


Fig. 1.—Diagram of Arc Method of Transmission.

During the past summer a great many experiments were carried on between the Brant Rock station and a small schooner having a mast 70 feet high, and communication was easily maintained up to distances of ten miles from shore with an expenditure of less energy than is required to operate a 16-candle-power lamp. A station at Plymouth was constructed to permit of work being carried on during the winter, when it was too rough to permit of the use of the schooner. It was between this station and the Brant Rock station that the recent tests were made. Fig. 2 shows the connections used for talking directly from one station to the other, and Fig. 3 the connections using telephonic relay for talking from one local exchange to another exchange.



Wireless Telephone Transmitter.

The illustrations show a form of transmitter, and the method of testing the sensitiveness of the various transmitters by a phonograph talking record and a dynamo used with one form of apparatus, capable of giving 80,000 alternations per second, but generally run at from 50,000 to 60,000. This dynamo, while of the general type described in U. S. patent 706,737, nevertheless required for its construction a very great amount of engineering skill. To the engineers of the General Electric Company, who constructed it, more particularly Messrs. Alexanderson Reist, Dempster, and Geisenhoner, is due the credit of this remarkable engineering feat. During the test not only speech but phonographic talking records and music were transmitted, all being received with perfect clearness and distinctness, the transmission being about equivalent to a thirty-mile cable. No extraneous noises of any kind were heard in the receiver, the wireless telephone being in this respect markedly in advance over the regular wire lines. As developed at present, the system is capable of maintaining communication between ships 100 to 150 miles apart, and there is little doubt

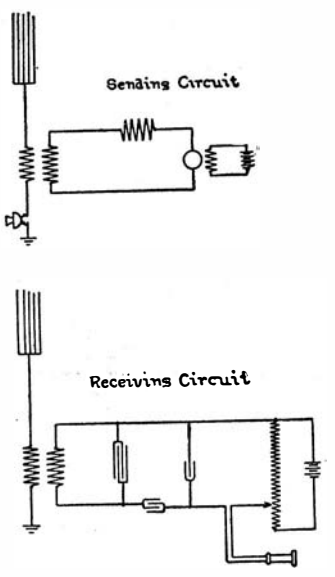
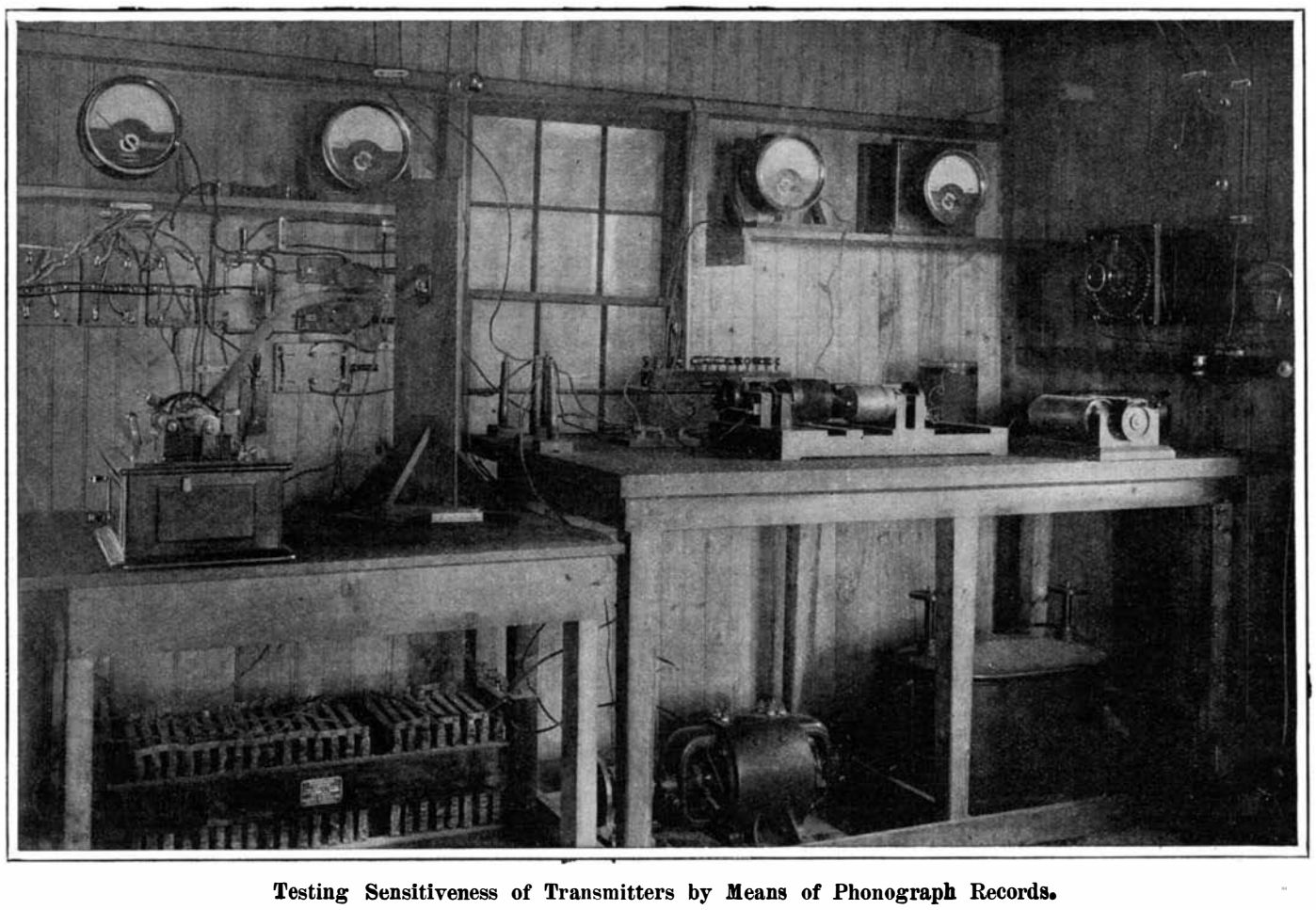


Fig. 2.—Connections for Direct System.



Testing Sensitiveness of Transmitters by Means of Phonograph Records.

that much longer distances will be covered in the near future.

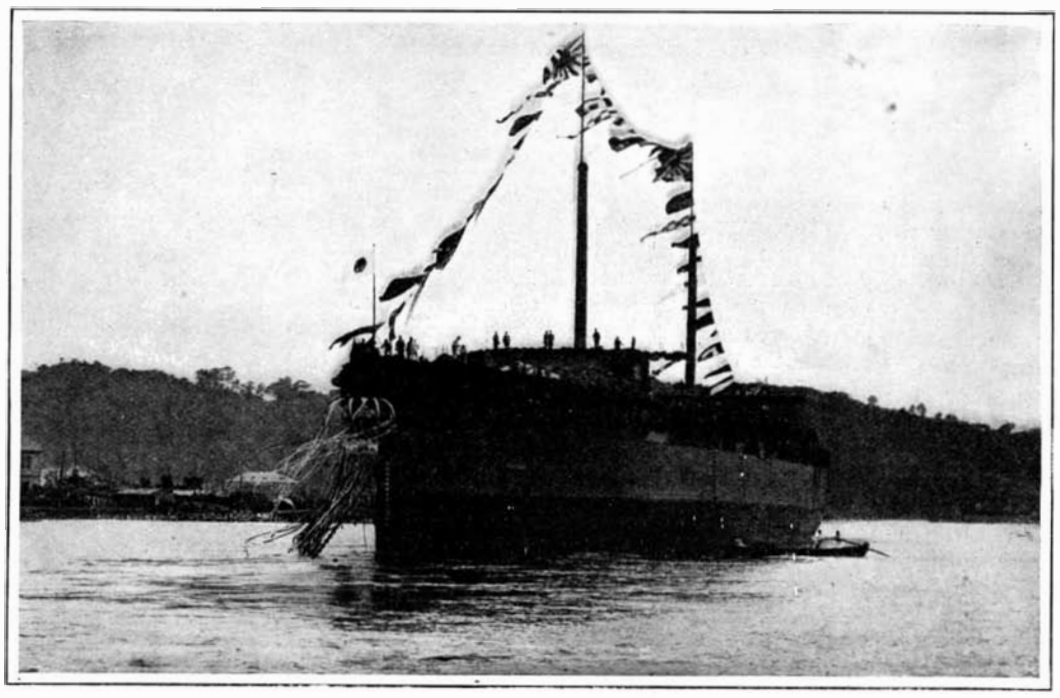
A method has now been put in use whereby messages can be printed on receipt at the receiving station (the messages being transmitted by typewriter).

THE LAUNCH OF THE "SATSUMA."

To the Editor of the SCIENTIFIC AMERICAN:

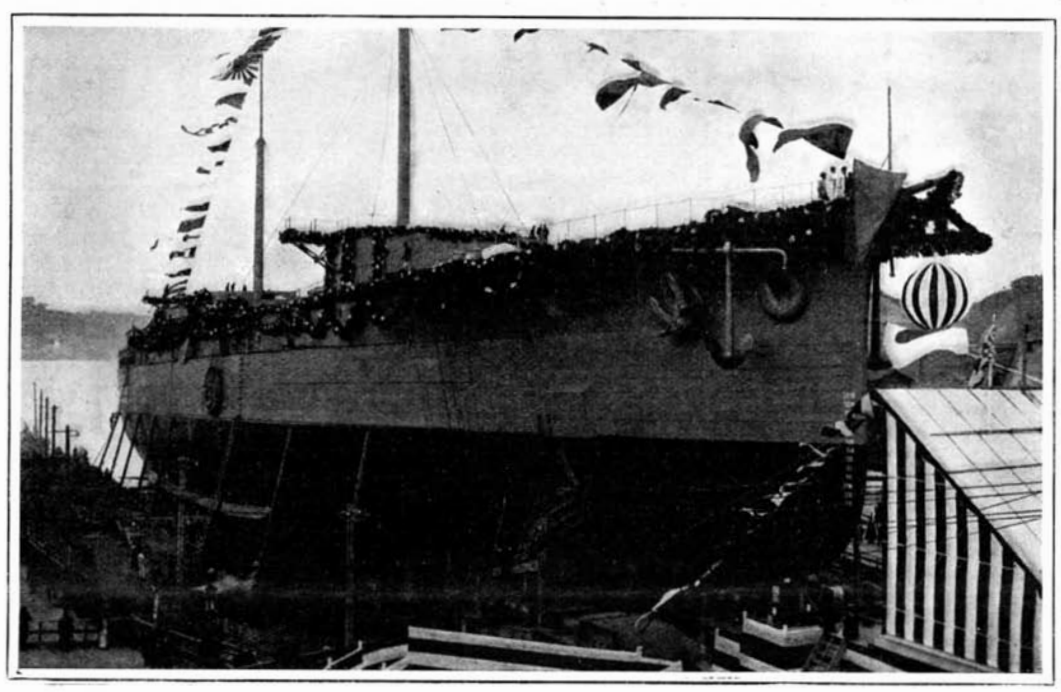
One year and one month after the peace of Portsmouth, which was brought about by the noble efforts of your great President, the launch of the largest battleship afloat took place in the presence of H. M. the Emperor, the Crown Prince, many princes and princesses, and a huge number of all classes of people, at the Yokosuka navy yard, which is but five miles from Uraga, where the monument to Commodore Perry stands.

The battleship "Satsuma," the construction of which began in the midst of the Russo-Japanese war, is 482 feet in length, 83 feet 6 inches in beam, of 19,200 tons displacement and 18,000 horse-power. Her armament is not yet officially declared, and will be kept secret until completion. But the authorities, it is said, at first intended to provide four 12-inch guns, twelve 10-inch guns, twelve 4.7-inch guns, and five torpedo tubes. Thus it will be seen that Japan has not dispensed with intermediate armament, as is the case with the "Dreadnought." Incessant progress in naval matters, however, calls for some new alterations and improvements to be introduced to the armament; and the "Satsuma" will, it is believed, be finally found to be more powerfully equipped than was originally intended. Her armor belt of Krupp steel ranges from 5 to 9 (or 9½) inches, and her intended speed is 19 knots. The ram bow has been dispensed with in her, as in the two armored cruisers, "Tsukuba" and "Ikoma," just built respectively at Kure and Yokosuka. She has a very handsome semi-fiddle bow. Over a year ago, Admiral Sir Cyprian Bridge said it would be interesting to see how long the ram bow would be a feature of warship design. So far as the Japanese are concerned, the day of the ram has passed away, and will not be revived in our future warships, unless some development, as yet undiscovered, is made hereafter in naval warfare. When the "Satsuma" is fully equipped she will also be without the fighting tops so common in modern warships. Compared with our latest battleship, "Kashima," she has a larger displacement by 2,600 tons, and in armament has eight more 10-inch guns. Not only is the "Satsuma" much superior to the "Kashima" in her exterior design, but the difference in her interior design is incomparably greater, owing to the fact that in the construction of the "Satsuma" every available experience obtained from the late war has been turned to account. The new battleship has a larger displacement than the "Dreadnought" by 1,300 tons, though she is inferior in point of speed; and there is a question as to the comparative strength of the two battleships' armaments. The "Satsuma" has four 12-inch and twelve 10-inch guns against the "Dreadnought's" ten 12-inch, so that in fire the latter oppcses six 12-inch to the former ship's twelve 10-inch. The allied nations are to be congratulated upon their possession of the two most powerful battleships in the world. In the construction of warships, the most valuable of all experiences are undoubtedly those derived from the tests of actual engagements. A battleship, designed by the experts of a country which has had various experiences of modern naval warfare, cannot fail to have many characteristics peculiar to itself; though the public are yet in the dark as to the details of those characteristics.



The "Satsuma" After the Launch.

The striped ball hanging at the bow was opened at the launch, liberating a flock of pigeons.



Length, 482 feet. **Beam,** 83½ feet. **Displacement,** 19,200 tons. **Horse-power,** 18,000. **Speed,** 20 knots. **Armor:** Belt, 9½ inches. **Armament:** Four 45-caliber 12-inch; twelve 45-caliber 10-inch; twelve 50-caliber 4.7-inch. **Torpedo tubes,** 5.

LAUNCH OF THE JAPANESE BATTLESHIP "SATSUMA," THE LARGEST BATTLESHIP AFLOAT.

On November 15, when the launch had been arranged to take place, His Majesty entered the imperial stand at about 2 P. M., which faced the stem of the ship. Preparations for the launch were soon commenced. The shores supporting both sides of the hull, the wedges, etc., were removed in accordance with signal orders Nos. 1 to 14. The Minister of the Navy, Vice-Admiral Saito, then proceeded before the throne and read the following document: "On the 15th day of May in the 38th year of Meiji (1905) the construction of the battleship numbered B was commenced, and the hull having now been completed, His Majesty is pleased to name her 'Satsuma.'" The Minister handed the document to Vice-Admiral Kamimura, commander of the Yokosuka naval station, and the latter immediately instructed the superintendent of the arsenal, Vice-Admiral Ito, to launch the ship. As soon as the cord was cut by Vice-Admiral Ito, the hull began sliding. As the "Satsuma" was smoothly going down toward the water, a ball hanging from her bow, as shown in one of the photographs, was automatically broken, scattering pieces of colored paper, cloth, flowers, etc., from among which several pigeons flew away. The thunderous *Banzai* and applause continued for a time. The ship was entirely afloat at 2:25 P. M. It may be added that the "Satsuma" has been built entirely by Japanese experts, and there is no truth whatever in the reports circulated in Europe as to a number of foreign engineers having been employed.

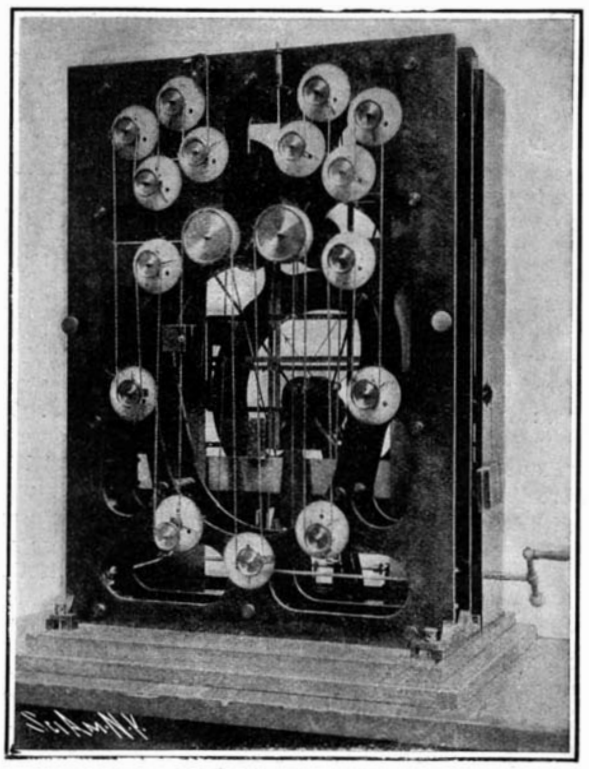
SAITO TSUNETARO.

The Imperial Fisheries Institute, Etchujima, Tokio, November 23, 1906.

A MACHINE THAT PREDICTS TIDES.

BY D. A. WILLEY.

One of the most interesting devices utilized in connection with the United States Coast and Geodetic Survey is the mechanism by which the state of the tide at a certain seaport can be closely determined a year or more ahead. While with the machine are used tide tables which have been computed for a period of years, the automatic computation which the tide predictor performs is really wonderful in its accuracy. As the illustrations



Rear View of the Machine, Showing the Arrangement of Mechanical Elements.

Operator Turning Indices to Determine the Height and Time of the Tide at a Future Date.

A MACHINE THAT PREDICTS TIDES.

indicate, the tide predictor somewhat resembles a clock. In fact, it contains one which records every day in the year, the pointer on the dial shown in the upper left hand corner of the illustration making a complete circle of the face of the dial once every twenty-four hours, but this is only one of several parts which might be termed clocks by reason of their mechanical construction and arrangement. There are clocks which serve to indicate when properly "set" the daily stage of tides, and the stage of the moon, so essential in calculating tidal movements. The center "clock," however, is of most importance, for by its manipulation the necessary computations are made with the aid of records obtained from the smaller ones.

The tide predictor contains nineteen mechanical elements or estimators, each consisting of an axle which is moved by a pulley and crank connected by delicately adjusted chains. All of the axles, however, are controlled by what might be called the governing axle located in the bottom of the framework of the predictor and moved by the handle shown in the illustration on the outside of the case at the left. It will be noted that the large dial in the center of the face of the predictor contains two sets of hands and incloses a small disk which has a single hand. The larger hands are called the lunar and solar indexes, for reasons which will be explained. The small index on the little dial serves merely to indicate the period of the day when the computation is made.

When it is desired to ascertain the height of the tide at a certain point on a specified date the operator of the machine first "sets" it so that the mechanism shows the approximate time at which high tide or low tide occurred on a given date in the past at this place. Then with the left hand the operator slowly turns the handle at the lower left-hand corner of the machine and this is what occurs: The hand on the large face in the center known as the lunar index changes its position until it points in the same direction as one of the pair of smaller hands or needles. The operator then notes the position of the solar index, as the other hand of this curious clock is termed. If the lunar index has assumed the same position as the upper needle, the solar index will indicate the time of the first high water at the seaport for which the computation is being made. To determine the height of the tide at the given time, the operator glances at the index at the left lower corner of the large face. Comparing the figures opposite its hand with the figures on the scale by its side gives the height of the tide.

To determine low tide the lunar index is moved by the handle until it is in the same position as the lower needle and the position of its companion, the solar index, is again observed. Thus the time of low tide is secured. In getting the measurement of the tide the index on the lower right-hand side is read and the figures compared with the right of the two measures seen in the lower part of the frame.

Fully to describe the workings of all the mechanism would require more space than can be given, but it should be remembered that when the handle controlling the governing axle is turned, all of the elements are set in motion at a speed proportioned to the work which they are to perform, regulating the various hands and needles so that no errors of importance can be made. As an indication of the accuracy of the machine it may be stated that the maximum deviation of the tide from what has been predicted is never over 0.3 foot, and it records the stage of tide within five minutes of the time when the tide reaches the stage, although, as stated, the prediction may be made a year or more in advance. The machine is a portion of the division of the bureau at Washington of which Mr. O. H. Tittmann is superintendent, and is called the Ferrel tide predictor after the late William Ferrel, by whom it was improved, the original invention being due to Lord Kelvin.

A fuller description of this type of predictor will be found in Scientific American Supplement No. 1464.

Variable Speed Turbine Engine.

A turbine has been patented in England which, by means of two sets of steam admission ports, into either of which steam may be admitted at will, it is claimed will give two different speeds of operation at the same efficiency. For the higher speed the steam is conducted from one set of ports through expanding nozzles to the rotor, where it encounters two sets of moving blades and one set of fixed blades, passing thence to the exhaust. For the lower speed, the steam takes the same path through the blades as before, and is then led from the second set of moving blades into a group of blades consisting of two fixed and two moving sets. This arrangement gives a speed about half that due to the other, the reason being doubtless that, the expansion being carried through a longer stage, the drop in pressure at each set of blades is but half what it was before, with consequent proportional speed factor.—**Iron Age.**

Correspondence.

Large Powder Chambers Reduce Erosion.

To the Editor of the Scientific American:

Referring to your mention, in the Scientific American Review of the Year, of the high velocity secured at Sandy Hook with the Brown wire gun, which is officially reported as 3,740 feet per second, I beg to draw your attention to the fact that there were some important truths established during these tests, which show the great advantage to our government of high-powered guns, such as the department or Crozier gun and the Brown wire gun, viz.:

If these guns were fired with what the government considers service velocities for the 6-inch guns now in use, the pressures would be so exceedingly low that, with properly banded shells, they would last for an indefinite number of rounds, before being rendered unserviceable on account of erosion; and at least as long as any of the low-velocity guns now recommended by the department, so far as the life of the gun is concerned.

A study of the government record shows: The third round, Brown 6-inch gun, with 59 pounds of powder and 28,475 pounds pressure per square inch, gave 2,879 foot seconds velocity. The fourth round in Crozier gun, which also has an unusually large powder chamber, with 69 pounds of powder and 30,810 pounds pressure, gave 2,938 foot seconds.

These records prove, therefore, that the large powder chambers in the high-powered guns, so far from being undesirable, are a very great advantage; since such guns give higher velocities with lower mean pressures than the 6-inch guns now in use. This is possible because more powder can be burned, and a larger volume of gas secured, without producing excessive pressures. As a matter of fact, nearly 10,000 pounds less pressure per square inch is required than in the 6-inch service gun, to secure the same velocities. Hence, erosion would be correspondingly reduced.

Another important advantage in the high-power gun is that, even if fired with the usual 6-inch service charge, it possesses tremendous reserve energy, to be available in an emergency, when long-range firing may be of inestimable value to cripple the enemy before he could approach near enough to strike.

Gen. Crozier, Chief of Ordnance, implies, in his annual report recently published, the possibility of eliminating erosion, in which event, with these high-powered guns, the government would be in possession of guns of far greater efficiency and range than any other guns within our knowledge, while on the other hand, if our government has low-powered guns only, and erosion should be cured, as it undoubtedly will be, we would be left with a large number of inefficient and obsolete guns.

The government star gaging records show that in the last ten excessive pressure shots from the Brown 6-inch gun there was practically no erosion at all in the last 14 feet of the muzzle end of the gun, because the shells had been properly banded to meet the changed conditions which were required in the gun in order to secure such remarkable results in pressures and velocities.

If all the shells had been banded at the beginning of the test, as the last ten were, both the Crozier gun and the 6-inch Brown wire gun could easily have been fired the 250 rounds originally proposed and been in better condition at the finish than they are to-day.

The greatest erosion occurred during the early part of the test, when the narrow bands were used, as the star gaging shows, and was no fault of the system of construction. It was claimed at the start that the shells were not properly banded for such high pressures and velocities, but the department insisted that the service bands for low-powered guns must be used in this test of the high-powered guns.

The last ten shots (88th to 98th) fired in the Brown 6-inch gun gave an average pressure of over 55,000 pounds per square inch and an average velocity of over 3,600 feet per second with perfect safety to the gun.

John H. Brown.

New York, January 8, 1907.

The Exploration of the Atmosphere at Sea.

To the Editor of the Scientific American:

In your issue of December 22, 1906, your German correspondent speaks of the research boat "Planet," belonging to the German marine, as if she were the first vessel to make atmospheric soundings with kites and balloons. Permit me to say that kites were used by me to obtain meteorological observations at sea, independently of the natural wind, in 1901, as was related in the Scientific American, vol. 91, page 479. The same year, after this method had been proved successful on a transatlantic steamer, I proposed (in a paper read before the Glasgow meeting of the British Association) to extend it to the trade-wind region. In order to organize such an expedition, applications for aid were addressed in 1902 to the Prince of Monaco, and in 1903 to the Carnegie Institution, but in neither case was the desired assistance obtained. However, Prof. Hergesell, president of the International Committee for Scientific Aeronautics, of which I am also a member, succeeded in interesting the Prince of Monaco in the scheme, and upon his yacht, the "Princesse Alice," during the summer of 1904, kite flights were made in the region bounded by Spain, the Azores, and the Canaries. Although a height exceeding that of the Peak of Teneriffe was several times attained, the southwest or return trade, which had been observed on this mountain, was not found, leading Prof. Hergesell to conclude that it was due to the disturbing effect of the mountain itself.

This conclusion, which involved so important a matter as the existence of the return trade, led to another expedition being sent out in the summer of 1905 by M. Teisserenc de Bort, director of the Observatory for Dynamic Meteorology at Trappes, near Paris, and by the writer. Mr. Clayton, of the Blue Hill Observatory, in proceeding from Boston to Gibraltar executed with kites the first line of atmospheric soundings across this part of the Atlantic to an average height of 3,000 feet. At Gibraltar Mr. Clayton joined the steam yacht "Otaria," a vessel of 350 tons, purchased and equipped by M. Teisserenc de Bort expressly for exploring the atmosphere, and having on board M. Maurice, of Trappes Observatory. This vessel went as far south as latitude 10 deg. N. and as far west as longitude 30 deg. W., and in seventeen kite flights the barometric pressure, air temperature, relative humidity, and wind velocity were continuously recorded, and the wind direction observed by measuring the azimuth of the kites. To obtain the direction and speed of the wind at greater heights, eleven hydrogen balloons were liberated from several of the islands, from which they were measured trigonometrically, and within the region of the northeast trade all indicated the expected south or southwest return trade above the height of about two miles. The same year Prof. Hergesell made another cruise on the "Princesse Alice," employing for the first time at sea the tandem balloons of rubber, which your correspondent describes as forming part of the equipment of the "Planet," and in this way the first temperatures and humidities were obtained up to an extreme height of about ten miles above the ocean. During the past winter and summer, the "Otaria," equipped with these *ballons-sondes*, captive balloons, and kites, has made two cruises, proceeding across the equator to Ascension Island, at the mutual expense of her owner and the writer. The existence of the southwest current above the northeast trade, and of the northwest current above the southeast trade, was demonstrated, and the hitherto unsuspected fact revealed that in summer at a height of eight miles above the thermal equator a temperature of about 100 deg. F. below zero prevails, which is lower than it is in winter at corresponding heights in temperate regions.

Mention of these researches shows that your correspondent is greatly in error in assuming that the "Planet" has an unknown field to explore, because the conditions in the higher atmosphere over the ocean "are known only through a few observations made in the North Atlantic"; but I entirely agree with him that "these conditions are not as simple as theory has heretofore assumed," and that further observations are desirable.

A. Lawrence Rotch,
Director of Blue Hill Meteorological Observatory.
Hyde Park, Mass., December 27, 1906.

The Wireless Telegraph Situation.

To the Editor of the Scientific American:

I read with great interest your editorial review of the scientific and engineering work for the year 1906. May I be permitted to make a few corrections to the *résumé* of wireless telegraphy work, as the writer of this part of the review seems to be somewhat out of touch with recent developments?

In the first place, the work of the National Electric Signaling Company on transatlantic telegraphy is so very far from having been futile, that uninterrupted communication, with the exception of one day, was maintained between Scotland and Massachusetts from October 1 to December 5, and preparations were being made for placing these stations on a commercial basis when the tower at Machrihanish fell, owing to a defective joint in one of the guys made by an expert engaged from a Glasgow firm. The working up to the date of the accident was, however, so successful that the directors of the National Electric Signaling Company have decided that it is unnecessary to carry on the experimental developments any further, and specifications are now being drawn up for the erection of five stations for doing transatlantic and other cable work, and a commercial permit is being applied for in England.

As regards the question of interference, this ceased to be a vital question two years ago. The Electrical Review of July 6, 13, 20, and 27, 1906, published the results of independent tests of government officials, which showed that it was possible to cut out interference even when the interfering station was only 216 yards away. You will note that the transatlantic stations have been operating without interference, al-

though there are no less than six stations within a radius of thirty miles. As an illustration of the extent to which tuning has been carried, I would say that the transatlantic stations referred to cut out all interference outside of one-quarter of one per cent, and that with one of the later developments a test was recently made in which it was found impossible to receive the messages when the frequency varied more than one part in one million—in fact, signals could only be obtained by raising the frequency to about one-tenth of one per cent too high and then gradually lowering it to about one-tenth of one per cent too low, a few signals being caught at the instant when the frequencies coincided. It may be taken as an absolute fact that the trouble at the present time is not in cutting out interference, but in getting the two stations which are to communicate to maintain their frequencies sufficiently regularly. At the present time it has not been found possible to maintain the frequencies of the two stations closer than one-tenth of one per cent, and this is the problem at which our company is now working, i. e., not to cut out interference, but to maintain the frequencies of the intercommunicating stations sufficiently close, so that the messages will not be lost. So far from other stations being able to interfere, with the method at present in use messages are received on the *same aerial* on which messages at the same time are being transmitted.

As regards the so-called Poulsen system, this is nothing more than an inferior form of a type of apparatus which has been in use in the United States for nearly five years. Elihu Thomson in 1892 discovered this beautiful and ingenious method of generating high-frequency oscillations. I inclose a figure taken from his U. S. patent 500,630, filed July 18, 1892 (see Fig. 1, page 68). This method was first applied to wireless telegraphy by the National Electric Signaling Company in 1901, and broad patents have been issued to that company, covering not only the broad method of wireless telegraphy by means of continuous generated oscillations, but also broadly generating electro-magnetic waves by means of an arc and a continuous current source. For example, claim 20 of U. S. patent 706,737, filed May 29, 1901, covers broadly "A system of transmission of energy by electromagnetic waves including in combination a radiating-conductor and a source of alternating electrical energy or potential, said radiating-conductor and source being co-ordinated and relatively adjusted to generate and radiate a substantially continuous stream of electromagnetic waves."

Improved methods of using an arc and for wireless telegraphy were covered by U. S. patent 706,742, filed June 6, 1902; 730,753, filed April 9, 1903; and 793,649, filed March 30, 1905. Claim 22 of the latter patent reads as follows: "In a system of signaling by electromagnetic waves, the combination of a radiating-conductor operatively connected to a discharge-gap, a source of practically-constant voltage, and means for charging and discharging the discharge-gap circuit without an appreciable time interval between charging and discharging."

It will be seen that the so-called Duddell-Poulsen method is really the Elihu Thomson-National Electric Signaling Company method, and it may be mentioned that this method is covered not only broadly but in all its modifications and improvements by patents issued to the National Electric Signaling Company, not only in the United States, but in England, France, Germany, Canada, and practically all foreign countries, most of the patents dating since 1902.

The two great obstacles to wireless telegraphy at present are atmospheric absorption and the action of the governments in refusing permits for working. Atmospheric absorption, though marked, is not very important up to distances of one thousand miles, but at distances beyond this constitutes a considerable difficulty. This, however, can be overcome by using more power and in other ways. As regards the actions of the governments, this is the real important obstacle to the development of wireless telegraphy. The National Electric Signaling Company has been trying for more than four years to obtain permits to operate in different countries, but up to date without success in a single instance. This "hold-up" works a great injury to the business interests of the different countries. As an illustration, if permits could have been obtained, wireless telegraphy would have been in operation all through the West Indies, including Cuba, Jamaica, Trinidad, and Demerara, also in Bermuda, Sable Islands, New Zealand, Tasmania, India, and elsewhere; but though applications were made for permits, and a considerable amount of money spent in endeavoring to obtain them, in no instance was the request granted, although no subsidies were asked for and reduced rates were promised in every case. Nevertheless, in not a single instance was it possible to obtain a permit.

It is time to end all this talk about the disabilities and defects of wireless telegraphy. Wireless telegraphy is able to compete with cables to-day in any part of the world, and to give better service and at lower prices. The sole and only reason why the public are not sending cable messages for half the present price is because the cable companies and other interested parties have sufficient influence to prevent wireless companies from obtaining permits to operate. Let there be less talk about the deficiencies of wireless telegraphy, and a little more attention paid to the way the present methods of government control act to throttle new industries.

To give a couple of instances of this right here in the United States, the National Electric Signaling Company decided several years ago to construct a line of stations from Maine to Panama, and ordered the masts and equipment for these stations. Contracts were under way with shipping companies representing more than two hundred vessels, when the United States government came out with an announcement that it proposed to make wireless telegraphy a government monopoly to transmit messages free and to forbid private companies from operating on the coast. So all contracts were dropped, the masts and equipment for the stations are now rotting in a shipyard, and the apparatus is in storage. As another instance, the National Electric Signaling Company offered to equip and guarantee the operation of stations between Nome and St. Michaels in Alaska. This tender was refused, and apparatus was constructed by the Signal Corps which did not work. The United States Signal Corps then adopted the National Electric Signaling Company's apparatus, and installed it without paying the company a cent; and though one of these patents has been adjudicated not less than six times, the government is still using it, and in fact manufacturing it itself.

To conclude, the sole and only obstacle to the general use of wireless telegraphy and the taking of telegraphic communications is the stupid and very frequently dishonest course of action taken by the various governments. This can probably only be cured by the formation of a general wireless trust, which will have sufficient political pull in the various countries to secure sensible and fair treatment. It is, however, to be hoped that this will not be forced upon the wireless companies, for the reason that not only the interests of the public at large would be injured by such a trust, but also the development of wireless telegraphy would not proceed at as rapid a rate as it would if there were a number of competing companies. Those companies which, like the National Electric Signaling Company, are opposed to the formation of any such trust, are holding out in the hope that sooner or later public opinion will be awakened in the matter, and wireless telegraphy may get a fair chance to show what it can do.

R. A. FESSENDEN.

Western Tower, Brant Rock, Mass., January 8, 1907.

Position Occupied by the United States in the World's Iron Production.

According to the Rheinish-Westphalian Times, a leading technical paper of the German Empire, the world's iron production in 1903 was 40,004,837 tons; in 1904, 45,225,928 tons; in 1905, the last year for which figures were furnished, 53,997,965 tons. The United States is striding forward so fast in the production of iron that it promises to not only lead the great iron-producing countries, but to lead the rest of the world combined. The following table gives the ton production of the countries named during the years indicated:

Country.	1903.	1904.	1905.
	Tons.	*Tons.*	*Tons.*
U. S. of America...	18,009,252	16,497,033	22,992,380
Germany	10,085,634	10,103,941	10,987,623
England	8,811,204	8,562,658	9,592,737
France	2,827,668	2,999,787	3,076,550
Russia	2,402,500	2,855,032	2,765,000
Austria-Hungary ...	1,321,695	1,450,658	1,514,840
Belgium	1,299,211	1,307,399	1,310,290
Sweden	489,700	516,900	527,300
Spain	380,284	420,000	385,000
Canada	265,418	270,249	468,003
Italy	45,000	88,965	140,825
Japan	36,515	112,328	190,375
India	30,756	40,978	47,042

While the absolute gain in the United States is almost equal to the entire gain between 1904 and 1905, the advance in Canada in 1905 over 1903 is remarkable. The output nearly doubled. Still more remarkable is the advance in Japan, a gain in the two years of nearly 600 per cent. At the present rate of production the world's visible supply of iron, 10,000,000,000 tons, according to a Swedish expert's estimate, must soon be exhausted. Luckily these figures are believed to be far from the truth, as the United States alone is said to have more than 4,000,000,000 tons in mines that have been located. If this is true, it is more than probable that the vast deposits of Canada, Mexico, Central and South America were neglected by the Swedish scientist.

Engineering Notes.

The conditions which will beset the engineer of the twentieth century will be exacting beyond anything we now know. The importance of a strong foundation in scientific principles cannot be overestimated, for scientific principles are only the laws of nature. These principles cannot be learned readily after a man has begun his life work. His whole energy will then be devoted to applying these principles correctly, not in acquiring them laboriously. It will be a prime necessity for the technical college of the future to lay these foundations broad and deep. It will be regarded as a weakness for a college to teach its students only the knacks of the profession, only just enough to be an ordinary draftsman, a tolerable surveyor, or first-class linesman.

For operating gas engines on board ship, producers must have means for keeping up the temperature in the producer while the engine is running at slow speeds or stopping, since otherwise it will not start up again on account of lack of suitable gas. This can be readily obtained by keeping up the rate of gasification through the exhausting fan and returning the gas into the producer where it is consumed again, there being practically no loss but that of the sensible heat of the gas radiating through the piping and, of course, the power required for driving the fan. No producer can be regarded as up to date that does not embody means for automatically adjusting the amount of water or steam admitted together with the air into the fire bed in fixed proportions according to the load, since without this arrangement, the fire will grow dead at the lower loads and the engine will not be able to pull up to a higher load again when necessary. There are a great many questions that are yet unsettled, and await solution in producer theory and practice.

According to a notice in the German technical press, tests are being made on a large scale with a view to electrifying the Baden state railways. Current is to be supplied from a power station under construction at Wyhlen-Augst, where a turbine with an output of 1,500 horse-power is to be rented. It is calculated that an aggregate of 2,400,000 kilowatt hours will be required to supply the energy necessary for the electric operation. Three schemes have been suggested. That of the Siemens-Schuckert Works provides continuous current operation at 3,000 volts, with 40 ton, four-axle locomotives driven by 150 horse-power motors at two main speeds. The scheme of the Allgemeine Elektrizitäts-Gesellschaft provides single-phase current with three-axle locomotives at only one main speed. The former company estimate the cost of installation at 2,720,000 marks (about $680,000) and the working expenses at 331,087 marks (about $83,000), while the corresponding figures given by the Allgemeine Elektrizitäts-Gesellschaft are 2,281,000 and 349,700 marks (about $570,000 and $87,000) respectively. It may be said that the present cost of steam operation is 363,522 marks (over $90,000). It is expected that electric service will commence at the end of 1909.

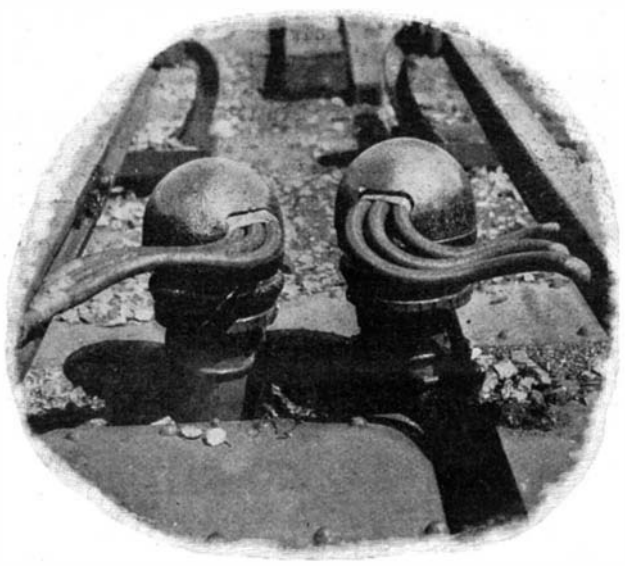
An invention which will prove of widespread utility to the textile industry has recently been devised conjointly by three English engineers for tow-carding upon an extensive scale. The machine is essentially of the labor-saving class, it being possible to accomplish as much therewith as has hitherto required fifteen hands. Tow, the by-product of flax, has heretofore always necessitated hand-feeding into the carding machines—one hand to each card. With this machine, however, this requisition is dispensed with. The tow to be carded is sorted and weighed, and then discharged through a shoot on to the table of the machine below. The operator here controls the feeding of the tow into the machine. The material is drawn into the lapper, as it is called, by a sheet and shell feed roller. It is then struck sharply by a rapidly-revolving cylinder, and discharged on to a traveling lattice sheet, which carries it forward to a set of pressing rollers. It is here formed into a large sliver, and is then lapped on to a wood core some 18 inches in diameter. When finished on the core the laps are doffed by hand, the full lap being withdrawn and the new core inserted without stopping the machine. The lap, which is 56 pounds in weight, is placed on a carrier, and transported by an elevated railroad to the carding machines and deposited where required. This lap is then laid on the sheet upon which formerly the tow had to be spread by hand, and the slow revolving of this sheet feeds the tow into the machine, the lap itself revolving as it unwinds its coil. Two of these machines are already in operation at one mill, and here thirty cards are fed entirely by them, only four hands being necessary to attend to the operation, as compared with thirty previously required. Even in this instance only three operators would be wanted if the two machines were installed in the same room. It is stated that owing to the saving in labor and time effected by these two machines, each has nearly repaid the initial outlay in the course of twelve months, while the work is more even and regular than what is obtainable by hand spreading.

OPENING OF ELECTRIC SERVICE ON THE NEW YORK CENTRAL AND THE NEW HAVEN RAILROADS.

The people who expected to enter the Grand Central Station on some specified day of opening, and find the noisy and more or less dirty steam locomotives gone and their place taken by the silent and cleanly electric locomotives and motor cars, have been doubtless much disappointed to find that the installation of electric service at this famous terminal is not going to be made in any such swift and wholesale fashion. On the contrary, so gradual will be the change, that no one will be able to say exactly when the era of steam ended and that of electric traction began.

The explanation of the comparative slowness of the change is to be found in the enormous magnitude of the operations, constructive and administrative, which are involved; in the fact that the whole of the work has to be carried through in the midst of what is perhaps the greatest congestion of terminal traffic to be found in any steam railroad center in this country; and in the fact that much of the work of electrification, at least in its application to these two great railroad systems, is more or less novel and has had to be built, and is now being tried out, without very much past experience to go upon. Consequently, although the new depressed station at 42d Street, which occupies the easterly portion of the terminal property, has been in service for about a month, the New York Central system is operating at present only about sixteen electrical trains a day on the local service to Yonkers. The New Haven system is about to open its electrical service by running only eight electrical trains daily between New Rochelle and 42d Street.

We have so frequently described the character of the improvements being made by these two railroads, that we will do no more in the present article than recapitulate the leading features of the work. The changes involved include the electrifying of the New York terminal for a distance of 34 miles on the main line from the Grand Central Station, and for 24 miles on the Harlem Division as far as White Plains, and the New Haven line from Woodlawn to Stamford. At present, only the first electrical zone of the New York Central, extending from the Grand Central Station to High Bridge on the main line, and to Wakefield on the Harlem Division, has been completed and put in operation, while the New Haven line will in a few days inaugurate its service from New Rochelle to New York. Temporary yards have been built at the two former places; but ultimately the great transfer points will be at Croton, on the main line, and White Plains on the Harlem Division, and at Stamford on the New Haven line. The local service of the New York Central is handled by trains which, for the present, are made up of motor cars and trailers, but which, ultimately, will be made up of motor cars alone, the multiple unit system of control being used. The motor cars are equipped with two 250-horse-power motors to the car, so that an eight-car train of all motor cars will have the great capacity of 4,000 horse-power, from which it will be seen that the speed of this service can be made as high as the demands of traffic and the judgment of the company wish to make it. The new motor cars, as shown in our engraving, are of



Third-Rail Jumper Connections Used at Cross-Overs.

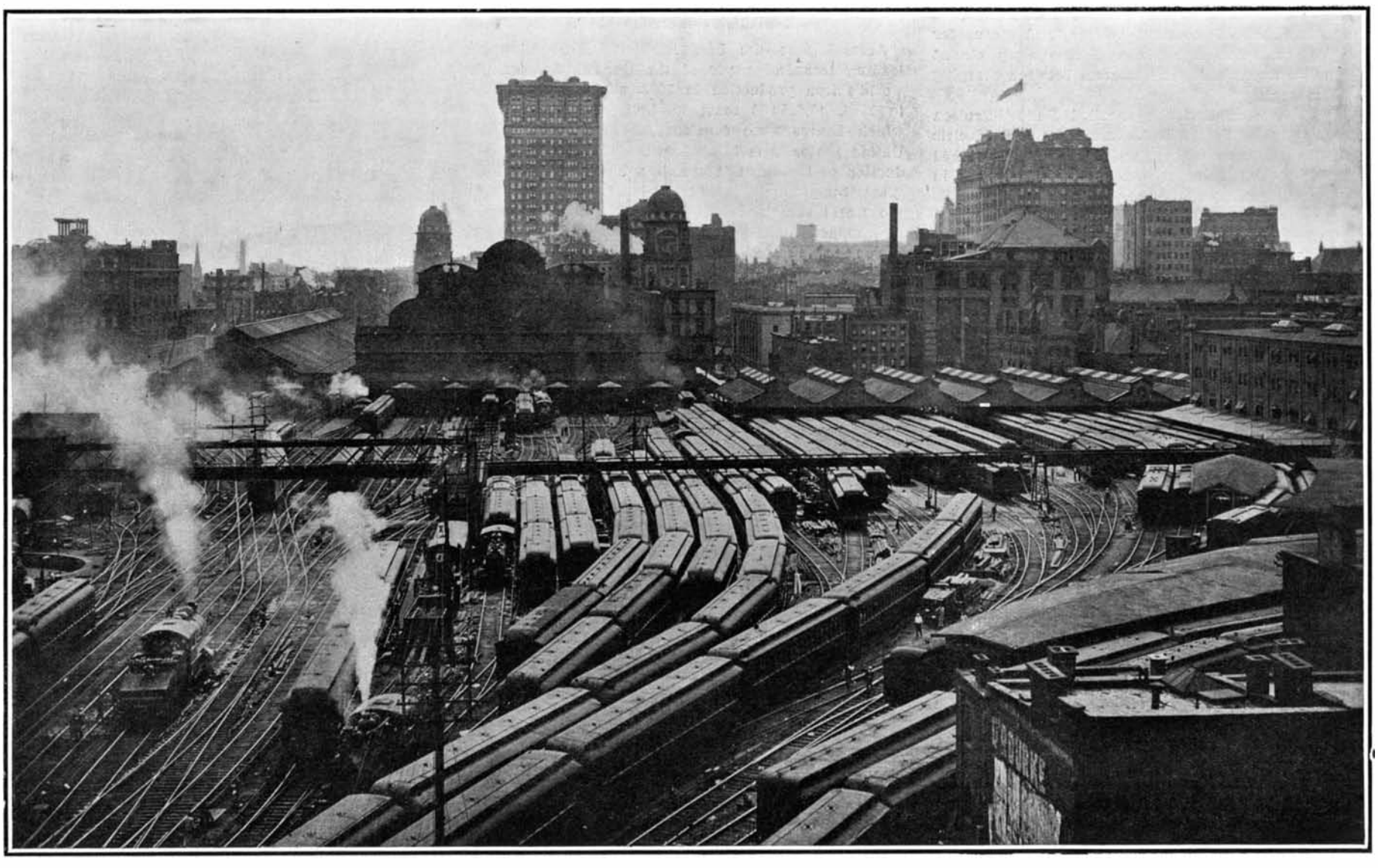
the all-steel type; they are electrically heated and lighted, and are provided with the hygienic woven cane seats and backs. A novel feature is the provision of electrical fans at each end of the car for securing good ventilation. The whole of the suburban service will ultimately be handled on the lower level of the new double-deck terminal station.

The heavy long-distance and express service will be hauled by electric locomotives of the type shown in our front-page engraving. This is a powerful and massive machine, weighing 95 tons, with 69 tons on the drivers. It is even more powerful than it looks, its maximum horse-power being 3,200, or double that of the heaviest steam locomotives engaged at present in hauling the express trains. The electric locomotive has advantages over the steam locomotive on every point of comparison. Its weight is 95 tons as against 162 tons; its maximum horse-power, 3,200 as against 1,600; its length, 37 feet as against 62 feet; and in spite of its smaller weight, the weight on drivers is 69 tons as against 55 tons of the express steam locomotive. That these splendid engines will be fully equal to their work, is shown by the tests made in experimental service, at Schenectady, when an eight-car train weighing 336 tons reached a speed of 30 miles per hour in 60 seconds, which corresponds to an acceleration of one-half mile per hour per second.

The New York Central electric zone has been built to operate with the direct current transmitted through the third rail. Two power stations have been built, one at Yonkers, the other at Port Morris; they are in duplicate, and each has a maximum capacity of 40,000 horse-power. The three-phase alternating current is produced by turbo-generators of the Curtis and General Electric type, stepped up and transmitted to substations of the general type shown in one of the accompanying illustrations, where it is stepped down to 660-volt direct current, at which pressure it is collected from the third rail by the contact shoes of the locomotives and motor cars.

The electrical commission of the New York Central Company is to be congratulated upon the excellent way in which they have worked out the constructive features of the transmission line and the third rail, both of which, as will be seen from our illustration, are very compact in construction and sightly in appearance. The third rail is carried on brackets bolted to the ties, and is excellently protected on the side and head by wood lagging. Contact is had with the under surface of the rail, and such a thing as accidental injury to employees and others, by contact with the track and feeder rails, would be impossible except under extraordinary circumstances. The line is carried on tapered latticed posts, of graceful design, bolted securely to concrete bases.

The electric zone of the New York, New Haven & Hartford Railroad extends for a distance of 22 miles, from Stamford to Woodlawn, from which point the New Haven trains run over the tracks of the New York Central to 42d Street. After careful consideration of the relative advantages of operation under the alternating and the direct-current system, the company decided in favor of the former, and the equipment of the line and the design of the power station and motive power was given to the Westinghouse Electric and Manufacturing Company. The power station has been built at Cos Cob, adjoining the waterside and the company's main line, where three turbine-driven generators have been installed, which are so wound that they will supply either single-phase or three-phase current. The current is supplied to the trolley system at a pressure of 11,000 volts, and of course there are none of the transforming stations along the line which form part of the equipment of any low-pressure direct-current system. Each locomotive, however, is provided with a pair of transformers,



The Grand Central Station, Looking South to 42d Street. The Whole of this Area Will be Lowered 15 Feet, and Below This Will be a Second Level for the Suburban Trains.

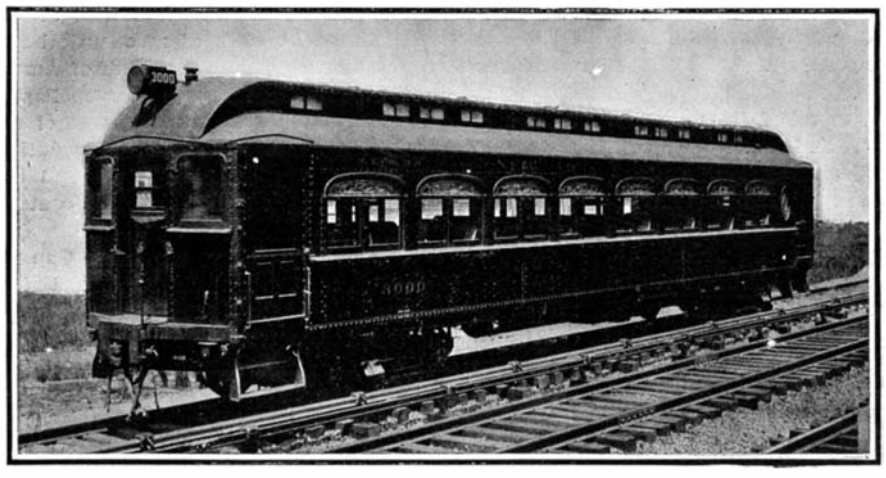
ELECTRIFICATION OF THE NEW YORK CENTRAL AND NEW HAVEN RAILROADS.

which step down the current to the working pressure. The current is collected from the overhead line by means of a pair of pantograph-type bow trolleys. Eight collecting shoes are also provided, for operating on the New York Central's third-rail system.

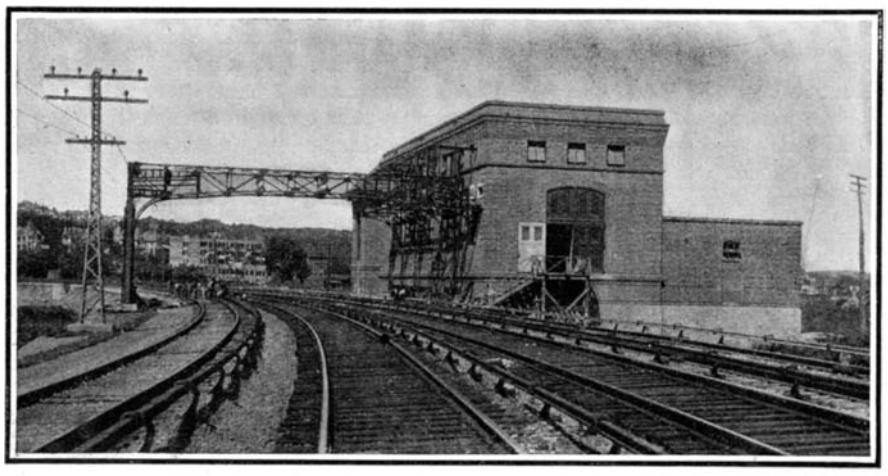
The construction of the transmission line and the trolley line forms perhaps the most interesting feature of the New Haven Railroad equipment. It was realized that for supplying current to trains, which frequently run over this section at speeds of as high as from 70 to 75 miles an hour, it was necessary to provide a trolley wire which would be true both as to level and line, as distinguished from the loosely hung and swaying wires of the ordinary trolley car service. The construction is as follows: At every 300 feet there is erected, upon massive concrete bases, a pair of heavy latticed posts about 2 feet square in section, which carry, at a height of about 25 feet above the tracks, a deep transverse latticed girder. The tops of the vertical posts project above this girder, and upon the projecting portions are strung the wires of the transmission line and signal service, etc. The latticed girder serves to carry heavy porcelain insulators, upon which are strung the ½-inch steel cables, which form the catenary from which the trolley wire is suspended. There are two of these catenaries for each trolley wire, and they are "cradled" by being drawn in toward each other, much the same way as the cables of the Brooklyn suspension bridge. The catenary cables are braced to each other and attached to the horizontal trolley wire below them by means of triangles made of ⅜-inch pipe. The triangles decrease in section from the girders toward the center of the span, and thereby serve to hold the catenaries to their curve and the copper trolley wire to its true line and level. The trolley wire is attached to the bottom of the triangles by means of bolted clips, which fit into grooves which run along the wire, one on each side of it. The wire has a height of about ⅜ of an inch and a width of about ¼ of an inch, and the current will be taken from the wire by the two horizontal bars, 2½ feet wide, of the locomotive trolleys.

The New Haven locomotives are relatively of small hauling capacity compared with the powerful electric locomotives of the New York Central service. They measure 36 feet 4 inches over all, and weigh about 85 tons. Each locomotive has four 250-horse-power motors, nominal rating, and each has developed a maximum power of about 1,450 horse-power, or considerably less than one-half the maximum power developed by the New York Central. Hence it will be necessary to couple two of these engines to make schedule time with the heaviest long-distance trains, although it is hoped that one locomotive will prove sufficient to haul the suburban trains.

As we have mentioned above, from Stamford to Woodlawn the locomotives will operate under the alternating current, taking power from the overhead line; from Woodlawn to New York, current will be taken by the contact shoes from the third rail, and the locomotives will operate by direct current.



A New York Central All-Steel Motor Car.



View Showing Transmission Line, Third Rail, and Sub-Station.

Small Distilleries Can Be Established for $200.

Internal Revenue Commissioner Yerkes, answering an inquiry recently as to how many gallons of denatured alcohol will approximately be needed in the industries for 1907, says:

"Having absolutely nothing to base an estimate upon, it is not possible for me to make an estimate as to the quantity of denatured alcohol that will be consumed in that way. No formal applications have as yet been made by distilleries for approval of denaturing bonded warehouses. Such applications could not be filed for the reason that the proper blanks have not as yet been placed in the hands of collectors. At present there are forty distilleries in the United States manufacturing what might be termed commercial alcohol."

In reply to a criticism of the law on the ground that regular distilleries only can engage in the manufacture of denatured alcohol, enabling the whisky trust to secure practically a monopoly, Mr. Yerkes said:

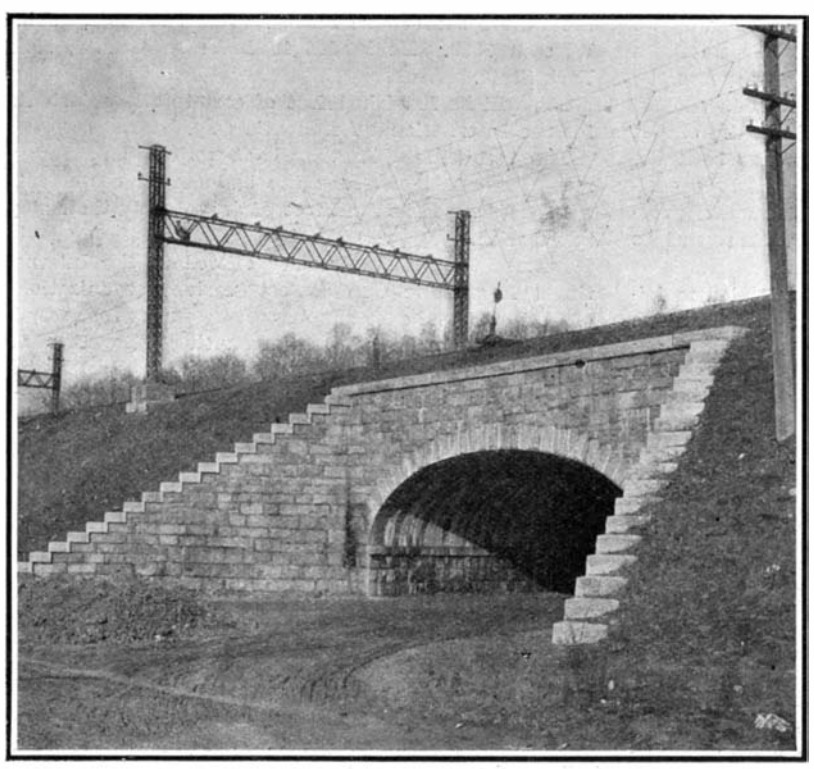
"This office knows of no process by which alcohol can be manufactured except by distillation, and as regular distilleries are the only kind recognized by the law, alcohol manufactured under the supervision of this department must be manufactured at regular distilleries. There are absolutely no limitations as to the size of a distillery that can be operated under the law. There are over 1,000 distilleries in operation now at each of which the daily spirit producing capacity is less than 30 gallons Many of these were set up on an outlay of less than $200. So far as the internal revenue laws are concerned, either in theory or practice, the smallest and crudest distillery can produce alcohol, if as a business proposition it is deemed advisable to do so. The small distilleries have always been treated by this department with the same consideration as the larger ones.

HOW A FARMER MAY PRODUCE DENATURED ALCOHOL.

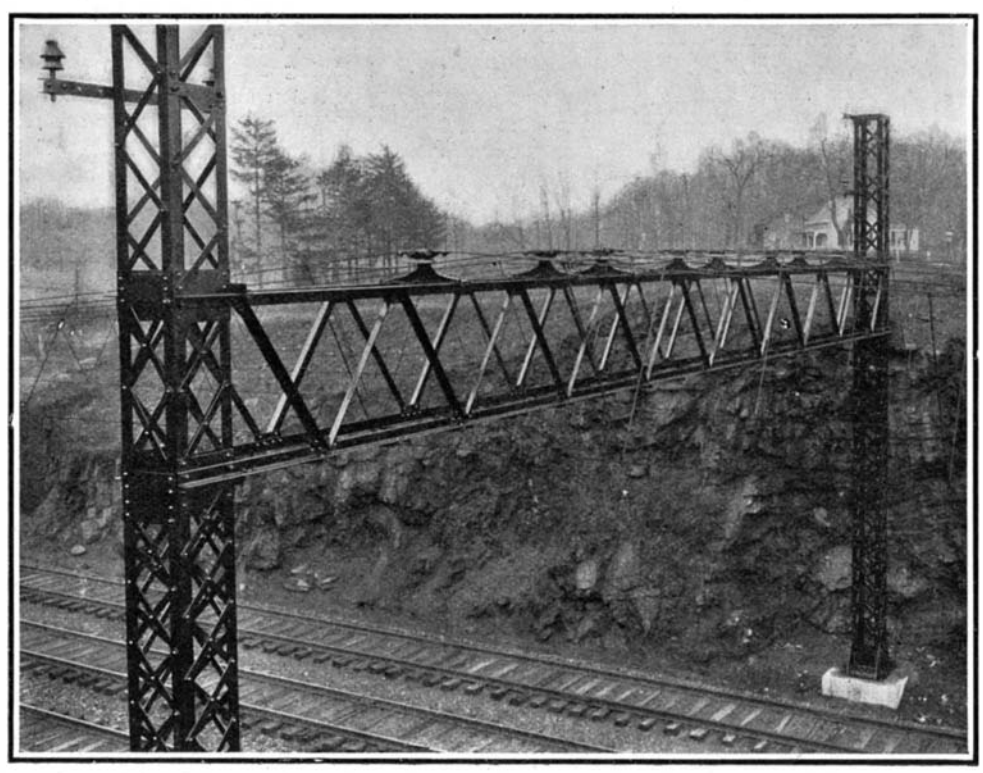
"If a farmer or other person desires to go into the business of manufacturing denatured alcohol, at a plant however small, he will be required to construct his plant in the manner prescribed by the general laws and regulations. He will be required to give a bond, the effect of which is to prevent him from defrauding the government of the tax on any distilled spirits produced by him. He will be required to establish a distillery warehouse; to deposit the spirits produced by him in this warehouse; to establish a denaturing bonded warehouse, and to pay tax or denature, just as he may wish, the alcohol produced by him. All of this will be done under governmental supervision, but the government pays for this supervision. The manufacturer of alcohol does not bear one cent of it. There is no objection to a farmer manufacturing his alcohol in his 'back yard' provided he wants to establish a distillery there. If you will take the trouble to investigate you will find, in my opinion, that the laws and regulations relating to the manufacture of alcohol in Germany do not differ to any great extent from the laws and regulations in this country."

The Pacific Ocean Exposition.

It has been decided to hold an international exposition in San Francisco in commemoration of the four hundredth anniversary of the discovery of the Pacific by Vasco Nuñez Balboa, and to celebrate the completion of the Panama Canal. A corporation named "The Pacific Ocean Exposition Company," with a capital of five million dollars, has been formed to carry out the enterprise. Among the objects of the exposition are mentioned the promotion and encouragement of libraries, historical researches, sciences and skill among the learned professions; the establishment of museums, aquaria, art galleries, libraries, places of amusement and recreation, and the erection of monuments in commemoration of historical events or periods. The board of directors includes many of the best-known citizens and business men of San Francisco.



A Sketch of the New Haven Trolley Lines, Showing the Method of Stiffening by Triangles.



Near View of Steel Posts and Truss, Showing Method of Attaching Catenaries.

ELECTRIFICATION OF THE NEW YORK CENTRAL AND NEW HAVEN RAILROADS.

SOME FACTS ABOUT TEA.

BY L. LODIAN.

Notwithstanding the almost universal use of tea, folks in general know very little about it—certainly little beyond that they drink a decoction of it, usually of the cheaper grade known as "mixed tea"—rarely a properly-made infusion; and that thrifty housewives use the refuse tea-leaves to "lay the dust" in sweeping. With the innumerable uses to which tea is put in other countries, they are unacquainted.

In China, tea-leaves are also used in sweeping floors, but this does not end their utilitarian purposes. In regions where fuel is scarce, the refuse leaves are pressed into bricks, dried, and used in the same manner as blocks of peat. This fuel is particularly prized for pork-curing—and the tea-cured or tea-smoked meat is to the Chinese what beech-nut and sugar-cured bacon and ham are to us. The ashes from the fuel are used as a fertilizer. But even before its use as fuel, the refuse tea serves another purpose. The leaves are vigorously stewed or allowed to steep in cold water, in order to recover the tannic acid which they contain (about 12 per cent). This is used in tanning leather and in dyeing textiles. It gives a fine, permanent nut-brown color, requires no mordant, and is unaffected by sunlight, bleaching, or washing. Sometimes the refuse tea-leaves are used as fodder for farm stock—at least providing bulk if not much nutrition. Again, they may be dried, mixed with the low-grade, factitiously-scented teas of commerce, and are then known as "lie-tea." The decoction resulting from such tea cannot be far superior to one made from the common hay with which we are all acquainted.

The queerest use to which brick-tea has ever been put in the orient is in the capacity of money. We find mention of this peculiar form of currency in Knight's Mechanical Dictionary, in the Encyclopedia Americana, and in Abbé Huc's Travels in Tartary, Tibet, etc. It is still in circulation as a medium of exchange in the far-inland Chinese towns and central Asian marts and bazars, southward to the Pamirs and Tibet, and northward across Mongolia, to the Siberian frontier. Between the Mongolian town of Urga and the Siberian town of Kiakta, there is usually as much as half a million taels of this money in circulation. At the latter place it ceases to be used as currency, and enters into the regular brick-tea trade of Siberia and Russia. As brick-tea, it is largely used in the Russian army, by surveying engineers, touring theatrical companies, traveling hunters and sportsmen, and tourists in general.

The value of the specimen illustrated in the accompanying engraving is about 2 taels, say $2.25; it is a high-grade bohea or black tea. The farther it gets from the eastern tea-growing regions, the more its value increases. By compressing more expensive teas, similar-sized bricks are produced representing values of $10, $20, $30, and upward. According to Abbé Huc, payments in Tartary are generally made for all commodities in brick-tea currency. Many of the highest-grade Chinese teas never leave the country—that is, are never exported in commercial quantities. Tea specialists in Europe and America manage to obtain specimens through corresponding firms in Chinese export centers, but these samples are not for sale. These rare teas are preserved for occasional comparison and testing with the general commercial teas; they are known as "unexported teas." I have known of only one person (outside of the tea-producing countries) who supplies the trade or the general public with specimens of the rare teas. His prices range from $75 to $100 per pound. As not even an expert can safely judge such tea by its appearance alone, it is necessary to taste it in the cup before purchasing. The vendor can hardly afford to dispense this $100-tea gratuitously, so a charge of $1 to $1.50 per cup is made; and as a judiciously-prepared infusion allows the making of about 200 cups per pound of tea, the profit from this tasting is almost gigantic. On rare occasions, exceptionally valuable teas, sold at auction in London, have brought from $225 to $275 per pound. But these fancy teas—almost literally worth their weight in gold—are rarely seen by ordinary people; they are preserved in sealed glass jars in the safes of the tea specialists who own them. Such exceptional teas are worth the high valuation placed upon them, and the purchases are not merely the results of some fad, for London's tea-center experts include some of the shrewdest tea-connoisseurs living.

Tea, not from the leaves, but from the flowers alone of the plant, is rarely encountered in commerce. The petals, stamens, etc., are sun-dried, and the resulting tea is of a rich, deep-brown hue of peculiarly delicate odor, and gives a pale amber-colored infusion rather more astringent in taste than that from the average fair-grade leaf. The taste for it is an acquired one, and even if this tea could be made commercially possible, it is doubtful if it would ever become popular.

The American tea-trade could advantageously take a suggestion from the brick-tea of the far east. In our country, the tea-dust, some of which is of good quality, is not properly utilized. In Europe it is a regular article of trade, and is advertised and sold as tea-dust. In America it is sold to thousands of cheap restaurants, who make from it the mixture of tannic acid, sugar, and boiled milk which they sell as "tea." If, as in the Orient, this dust were compressed into bricks, good tea could be made from it, and the product would find a ready market through the multitude of uses for which it is adapted. A beginning in this direction has been made by the Pinehurst tea estate in South Carolina, and in Europe similar advances have been inaugurated.

The virgin tea (*biepjcki-chi*), so called from its use at Chinese weddings, is the sun-dried leaf intact, tied up with three strands of colored silk. After infusion, these fagot-like little bundles are pickled in vinegar and used as salad. This tea is sold in especially handsome silk-covered and glass-topped boxes. The rarest of all teas, and one that has never been known to reach this country, is a naturally-sweet tea, produced in western China on a very limited scale. Its culture is centuries old, and the secret has been jealously guarded from generation to generation. The saccharinity is probably due to grafting and years of patient study and care, such as only the small Chinese tea-farmer is capable of bestowing.

The "body solidity" of Chinese teas is said to be far superior to that of the Indasian product. Experts claim that if Chinese teas and those of India or Ceylon be comparatively tested, it soon becomes apparent that the cup qualities of the latter are far more ephemeral, while those of the former are far more staying. This is believed to be the result of the tea-culture in India and Ceylon on large plantations by means of hired coolie labor, where there is no incentive to personal effort in the betterment of the product. In China, on the other hand, tea-raising has, since time immemorial, been conducted by small farmers, each owning a few acres of land, and bestowing upon his crop his entire time, labor, and intelligence, knowing, as it were, the condition and peculiarity of every bush; and this intensive culture has resulted in bringing the body-solidity of the tea to a remarkably high state of perfection. This is one of the reasons why we hear of Chinese teas—never Indasian ones—sometimes bringing more than $100 a pound. In late years the plantation and coolie system has been introduced into China by foreign concerns controlling the entire output of large tracts of country. The result has been the partial deterioration of Chinese tea, as has been commented upon by various writers, but China will probably always be able to hold her own with regard to the production of the higher-grade leaves.

CHINESE COMPRESSED-TEA MONEY (ONE-QUARTER ACTUAL SIZE).

In buying tea, a good rule for the uninitiated to follow is never to pay less than $1 per pound. Numbers of firms sell teas at $2, $4, and $6, and these are usually worth the price, though it is possible to purchase really good tea for $1. Fair grades of leaf may be obtained for 75 and 50 cents, but those selling under the latter value are not worth considering. It is very rare, by the way, to find good teas in small grocery stores, as these have not sufficient call for them to warrant carrying a stock. The leading kinds of black teas are *peko*, *kongu*, and *suchong* (*cianchang*). "Peko" is the Chinese word for "down," in reference to leaves so tender and undeveloped that they are still covered with a soft down—nature's protection for the budding leaf against sudden and undue chill. Among green teas we have the imperials, hisons, formosas, ulongs, etc. The latter are sometimes classed among black teas, though ulong is really a green tea of blackish leaf. The Chinese themselves class it among green teas

It is estimated that 75 per cent of the world's copper is obtained from sulphide ores.

Jamestown Aeronautical Congress.

In connection with the Jamestown exposition, an aeronautical congress will be held which, we trust, will be somewhat more successful than that of the St. Louis exposition. A committee recently met at the Hotel Astor in New York city for the purpose of arranging a series of demonstrations at the exposition with the latest apparatus. A comprehensive pamphlet is in course of preparation, which will set forth the expectations of the committee fully. Besides making experiments and flights, it is the intention of the committee to organize an exhibit of aeronautical material based upon that which the Aero Club of America has gathered during the last two years. Papers upon subjects which may be most timely and of the greatest value to the present stage of aeronautical developments are also to be obtained. Cups and trophies will be offered for the various aerial contests by the committee.

The Aero Club of America offers the Lahm Cup for the longest continuous flight made in the United States, exceeding 648 kilometers (402.64 miles) under conditions and regulations formulated by the contest committee of the club. This competition is open to balloons, dirigibles, and flying machines. Since the Gordon Bennett International Aeronautic Cup race in 1907 will be held in the United States under the auspices of the Aero Club of America, there will be many distinguished sportsmen from foreign countries in the United States. It is quite probable that they will assemble at the Jamestown exposition.

International Aeronautic Contest of 1907.

The Board of Directors of the Aero Club of America has decided in favor of holding the contest for the International Aeronautic Cup in 1907 at St. Louis. The city authorities of St. Louis have set apart for the starting point of this contest a portion of their city park known as "Forest Park." This place can be inclosed in such a way that there will be no interference with the inflation of the balloons, and the supply of gas will, in every way, be sufficient for quickly inflating all the balloons that will enter the contest. The ground is reached by a 24-inch main which leads from a gasometer one-quarter of a mile distant, which holds over 4,000,000 cubic feet of pure coal gas. The gas will be forced by very large pumps, so that inflation can be accomplished in the speediest possible manner. The average specific gravity of the gas furnished by the local gas company during the year 1906 was 0.43.

The club proposes to hold the contest during the period of full moon in the month of October—probably on October 19. According to the information obtained by the Weather Bureau during a long period of observations with kites and pilot balloons, the usual wind prevailing at that season of the year in the upper altitudes proceeds in an easterly direction toward New York, avoiding the Great Lakes, going to the south of them. Fine weather is invariably to be expected at this season of the year, there being usually but three or four days of rain in the month of October. The average temperature at the surface of the earth in this month is about 68 deg. F. It will be recalled that the greatest known balloon flight ever made in the United States was made from St. Louis by John Wise in 1859. He landed in Jefferson County, New York State.

Gas will be furnished free of cost to all contestants for the International Aeronautic Cup.

The Aero Club of America is at work on an arrangement by means of which the balloons of contestants will be admitted in bond free of duty during their stay in America.

Besides the prizes annually offered in the International Aeronautic Cup contest, various organizations of St. Louis will offer supplementary prizes for second, third, and fourth places, amounting altogether to about 5,000 francs ($1,000).

For those wishing to make trial flights in preparation for the International Cup contest, or for those wishing to compete for the Lahm Cup, which will be offered for competition by the Aero Club of America after March 1, 1907, arrangements have been made to supply gas at a specially reduced rate. This applies only to pilots recommended by the Aero Club of America. The rules of competition for the Lahm Cup will be announced later. Contestants will be afforded every facility by the gas company at St. Louis.

Entries for the 1907 contest for the International Aeronautic Cup close on February 1, 1907.

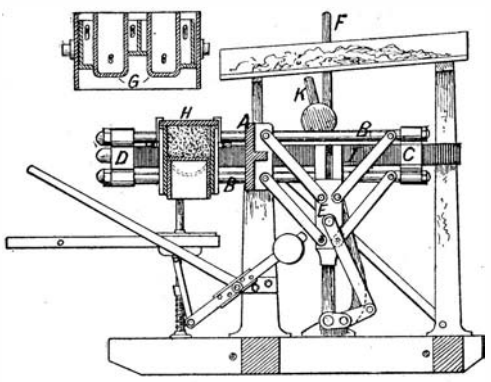
Tweezers are so frequently used for removing infinitesimal particles from the skin that it has occurred to some genius to make a combination of tweezer and magnifying glass. This is a small folding affair taking up little room in the pocket, and in use the glass is held suspended directly over the point of the tweezers.

Patent Department

A NEW CONCRETE BLOCK MACHINE.

A marked advance in concrete block machinery has been recently made by a western manufacturer, Mr. George P. White, of Wallace, Idaho, after three years of continuous experimental work. The machine, which is now in the hands of the American Hydraulic Stone Company, of Denver, Colo., is used for making what is known as two-piece walls. An important feature of the machine is the use of multiple cores and followers, which are individually movable in the mold through various distances proportionate to the volume of material to be compressed.

One of our illustrations shows a longitudinal section



SECTION SHOWING DETAILS OF THE BLOCK MACHINE.

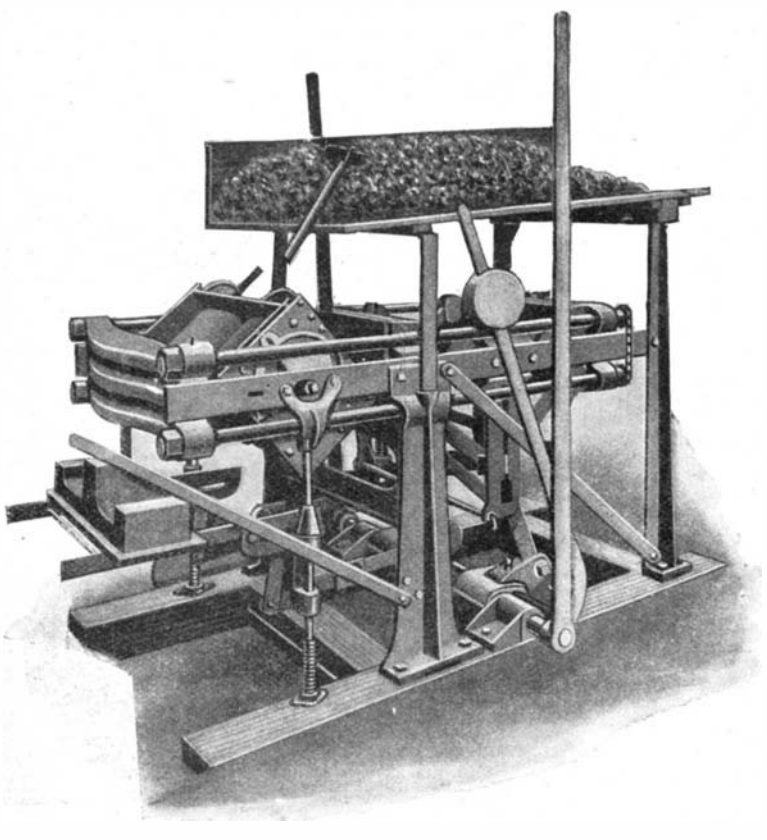
of the machine. The press head indicated at *A* is movable, being mounted at each end on a pair of horizontal bars, *I*. Above and below these bars, and parallel thereto, the pressure rods, *B*, are mounted. The lower ones on each side passing through an opening in the main frame are coupled together at each end by cross heads, *C D*. The cross head, *C*, and the press head, *A*, are connected by toggle links to a pair of slides, *E*, mounted to travel in vertical ways on opposite sides of the machine. A link connects each slide with an arm on the starting shaft, which in turn is carried in arms keyed to the main pressure shaft. By operating the starting lever, *K*, the slides will be caused to move vertically upward in their ways, and owing to the toggle link connection the cross head, *C*, and the press head, *A*, will be moved apart along the bars, *I*. Since the rods, *B*, are secured to the cross head, *C*, they will be moved bodily therewith, carrying the cross head, *D*, toward the press head, *A*. Between the cross heads, *D* and *A*, the mold, *H*, is mounted, and the operation thus far has brought the heads together sufficiently to make a partial pressure. The two pressure levers, *F*, are now operated, and pressure completed. A transverse section of the mold is shown in the machine in position to be filled with concrete, while the small detail view illustrates a longitudinal section of the mold in the inverted discharging position. The mold consists of a box frame open at the top and bottom. In this frame are the various cores and followers, *G*, adjustably attached to the same, permitting each to move independently of the other a prearranged distance. The center of gravity of the mold being unstable, the trunnions on which it is revoluble are located off the true center, thus adding greatly to the ease of movement. When the mold is in the filling position, the cores drop to their lowest positions with their ends projecting unevenly below the mold frame, in proportion to the amount of material to be compressed. After the mold has been filled with coarse concrete, a waterproof face of any desired color or texture can be applied, and a pallet, *H*, is placed over the top of the mold and secured by means of semi-automatic hooks. Then the mold is turned through an angle of 90 degrees with the pallet facing the press head, *D*. The operating levers are now drawn down to move the press heads together. The press head, *D*, is thus pressed against the pallet, while the press head, *A*, bears against the projecting cores, forcing them into the mold. A powerful compression is secured by the double toggle leverage, and the venting of cores and followers is so perfect, that no air is left in a pressed block.

After molding, the press heads return to normal position, and the mold is tilted. Below the mold is the lowering table, consisting of a pair of connected parallel bars mounted to move vertically up against the pallet. The pallet is then unhooked and moves down with the table as the latter is lowered, carrying the green block, which is thus pushed down by the weight of cores, which follow the block to face of mold, insuring a clean discharge. The table is balanced by a counterweight, and as it is mounted to travel on ways its movement is smooth, so that there is no danger of jarring the block as it is lowered out of the mold. The value of this lowering table, especially for heavy pieces, will be appreciated. As soon as the block is discharged, the mold may be turned over and filled for the next block.

The cores are so arranged that they can be readily removed and replaced with other forms, providing for blocks of different shapes and for walls of different widths. The machine adapts itself to a very wide range of construction, while but one size of pallet is used for any shape or size of block manufactured. A grave objection to concrete blocks has been the difficulty in meeting architects' specifications in cases where cut stone had been contemplated and courses of different heights had been specified. This difficulty is entirely overcome in the present machine by what is known as the "splitting device," which provides for the manufacture of blocks for any height of course or length of block in the same mold and with the same pressing plates. This splitting device is in effect a compressible partition conforming in section with interior of mold, which may be set at any desired place to block off the mold.

To make ornamental or rock face, a plate of desired form is used instead of pallet, *H*, and the block turned upon edge in the turning device, leaving the plates free for continuous use. Owing to the construction of mold case, having neither top nor bottom, it can be used either as a face-up or a face-down machine, greatly facilitating the manufacture of some special forms of courses.

Due to the perfection of the double toggle mechanism of the press, the pivotal features of the mold, the convenience of overhead mixture table, and the instantaneous action of cores in discharging blocks, the speed is accelerated to such an extent that four clever laborers, using a machine mixer, can make and place on curing cars a minimum product of 1,200 blocks per day. The machine can, of course, be operated by power by removing the six-foot operating levers and substituting a simple gear.



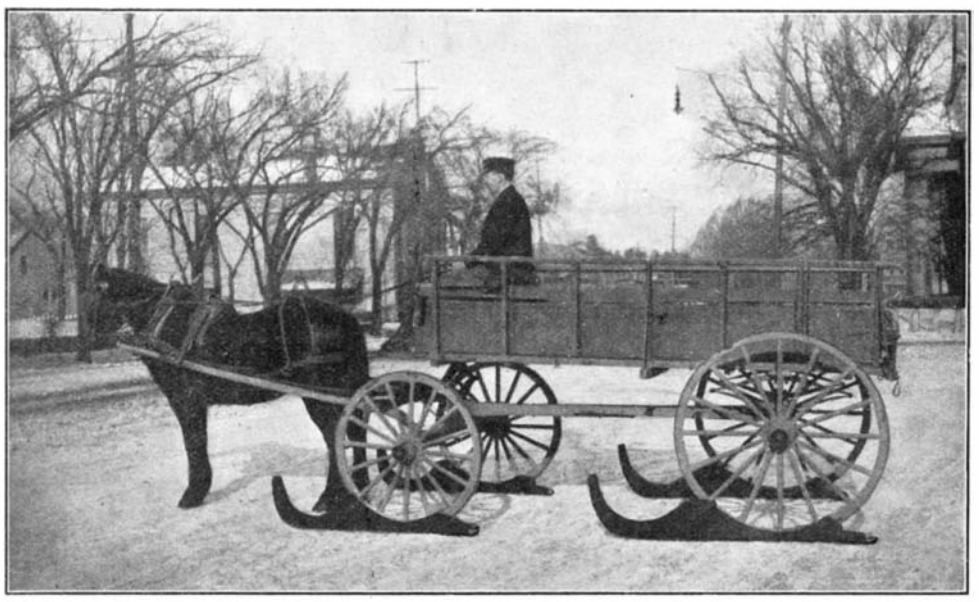
A NEW CONCRETE BLOCK MACHINE.

SNOW SHOES FOR WAGONS.

It may seem rather a curious notion to equip an ordinary wheeled vehicle with snow shoes, and yet that is what F. W. Nightingale, of Quincy, Mass., has done. By means of the invention, any wheeled vehicle can be converted into a sled in a few minutes. The shoes are placed on the ground, and the vehicle driven into them. Clamps are provided, by means of which the shoes can be firmly bolted in place. The inventor suggests that the runners may also be placed on the front wheels of automobiles to facilitate travel in the snow.

AN IMPROVED SELF-OILING ROLLER BEARING.

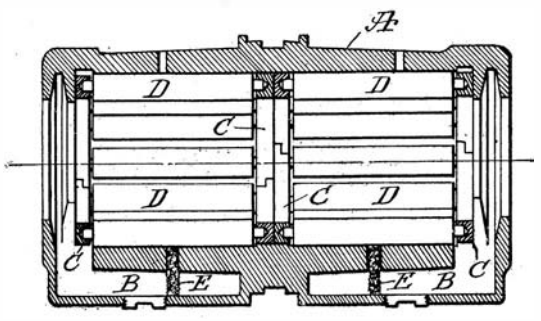
Most manufacturers will be surprised to learn how much power is lost in the shafting of their factories. An interesting series of tests was recently made in Cleveland, O., in sixteen different works using from 8 to 400 horse-power, to determine what percentage of the power was absorbed by the shafting. It was found



A WAGON EQUIPPED WITH SNOW SHOES.

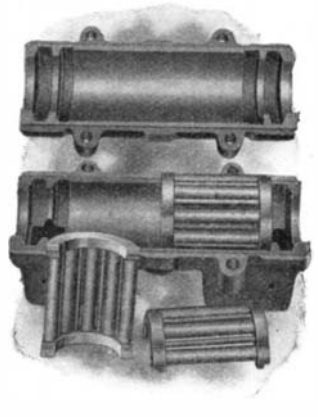
that in one-quarter of these factories 48 per cent of the power was used to drive the shafting, that the general average was 56 per cent, and that in one factory 80.7 per cent was thus lost, leaving but 19.3 per cent to drive the machines. It is needless to say that these shaftings were mounted in the ordinary babbitted bearings.

The importance of using anti-friction bearings is thus emphasized; for even if the first cost of anti-friction bearings is quite large, the saving in power which they are sure to effect will in most cases repay the initial outlay in less than a year. An excellent bearing



SECTION SHOWING CONSTRUCTION OF ROLLER BEARING.

of the anti-friction type made by George A. McKeel & Company, of Jackson, Michigan, is illustrated in the accompanying engraving. The bearing, which is self-oiling, is so constructed that no oil will be wasted. It is claimed that the oil saved by this bearing over the ordinary babbitted type is alone sufficient to pay for the bearing in a short time. One of the illustrations shows a sectional view which reveals the construction of the bearing. The shell, *A*, is made in halves which are bolted together. Extending under the lower shell are the oil wells, *B*. Mounted within the shell, *A*, are two pairs of rings, *C*, which form the bearings for two sets of rolls, *D*. The rings are made in halves, as shown, and their ends are formed to provide interlocking joints when the rings are assembled. In the lower shell are two ports which communicate with the oil wells. Fitted into these ports are a pair of wicks which are adapted to carry the

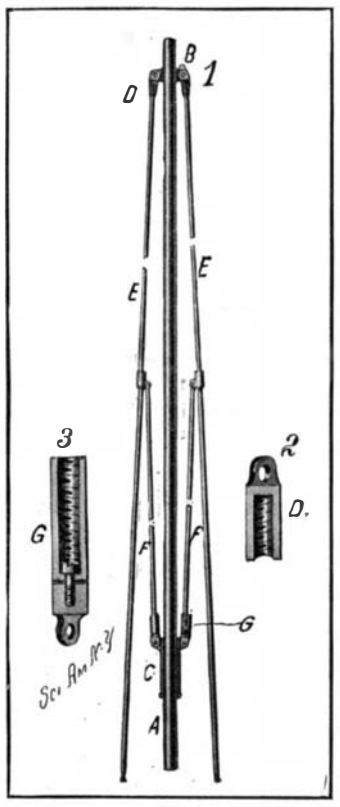


A SELF-OILING ROLLER BEARING.

oil to the rolls, *D*. Surplus oil flows to the ends of the shell and drops through openings into the oil wells. Thus a continuous circulation is maintained. A pair of spaced flanges formed at each end of the shell, *A*, prevents the escape of oil from the bearing.

UMBRELLA FRAME WITH DETACHABLE RIBS.

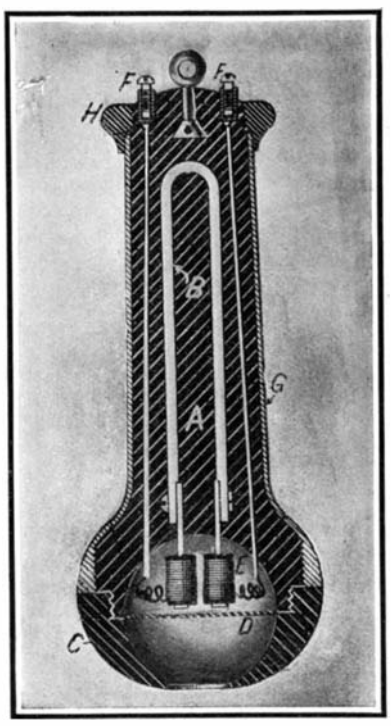
A new form of umbrella frame has recently been invented, in which the ribs and stretchers may be readily detached and replaced, when desired; thus, when a frame member breaks, the damage can be easily repaired. In general appearance, the frame does not differ from the ordinary, as will be observed in Fig. 1 of the accompanying engraving. The umbrella rod is shown at *A*, with the usual crown, *B*, and runner, *C*. Pivoted to the crown by means of a wire are a series of heads, *D*. Fig. 2 shows an enlarged sectional view of one of these heads, which will be seen to have a threaded bore. In this bore the upper end of the rib *E* is screwed. Intermediate of its length, each rib is provided with a lug to which the upper end of the stretcher *F* is pivoted in the usual manner. The lower end of the stretcher engages a swivel coupling *G*. This coupling is shown in detail in the sectional view, Fig. 3; it comprises an axially bored stud which is attached to a head by means of a screw in such a manner that it can swivel. The bore of the stud is threaded to receive the stretcher. The head of the coupling is pivoted to the runner *C*. If it be desired to remove one of the ribs, the stud of the swivel coupling is first turned to unscrew it from attachment with the stretcher, and as soon as the latter is released, the rib may be turned to unscrew it from the head *D*. In applying a new rib, the process is, of course, reversed, that is, the rib is first screwed into the head *D* and then the stretcher is made fast to the coupling *G* by screwing the stud upon it. A patent on this improved umbrella frame construction has just been granted to Mr. William Haeckel, of 804 Macon Street, Brooklyn, N. Y.



UMBRELLA FRAME WITH DETACHABLE RIBS.

AN IMPROVED RECEIVER FOR TELEPHONES.

Few persons who are not directly concerned with the telephone business have any conception of the expense to which a large telephone company is put each year in replacing damaged telephone receivers. In the ordinary construction, a thin shell of hard rubber is used to inclose the magnets and diaphragm of the receiving apparatus. This shell is so brittle, that it is liable to be cracked or broken if the receiver is accidentally dropped or knocked against a hard substance. With this in mind, Mr. Louis Steinberger, of 127 North 10th Street, Brooklyn, N. Y., has invented an improved receiver, of very solid construction, which offers little possibility of being damaged, and furthermore, it is formed with removable outer sections which, if marred, can be renewed at a small cost. The accompanying engraving shows a longitudinal section of the improved receiver, from which it will be seen to consist of a core, *A*, of insulating material, preferably "electrose," in which the usual permanent magnet, *B*, is imbedded. The core is enlarged at one end, and hollowed out to form a hemispherical concavity. A cap, *C*, provided with a similar concavity, is screwed onto a neck formed on the core *A*. The two concavities are separated by the diaphragm *D*, back of which is the usual electro-magnet, *E*. The latter is connected with the binding posts *F* by means of conductors imbedded in the core. Over the core a casing, *G*, may be fitted, to give a suitable finish to the receiver. This casing is preferably of metal, although the inventor does not limit himself to any special material. The casing is screwed onto the core at the forward end, and at the rear is held by a ring, *H*, screwed onto the core. In place of the locking member, *H*, as shown, an apertured cap may be employed for concealing the binding posts to conform with a certain type of receiver. The inventor has adopted the use of a spherical concavity about the diaphragm, because he has found that the acoustic properties of the receiver are greatly increased thereby, the intensity of the sound waves being apparently amplified by this arrangement. It will be observed that the large end of the receiver has the form of an oblate spheroid. This enables it to be applied to the ear with great precision, and also gives it a neat appearance. The globe rotundity of the receiver prevents undue catching of dust, and presents a surface which is easily cleaned or polished, all parts being readily accessible. The sanitary properties of the receiver are therefore greatly increased.



AN IMPROVED RECEIVER FOR TELEPHONES.

The scope of Mr. Steinberger's patent is very broad, as it covers not only a solid core, but also a hollow core of insulating material, nor does it limit him to making the outer case of the receiver detachable from the core section, as it may be molded permanently on the core.

Rejuvenation of Worn-Out Files.

The latest application of the air and steam blast is in the rejuvenation of worn-out files. A piece of portable apparatus has been recently introduced as part of the equipment of the workshop by which ninety per cent of the discarded files of the shop may be reclaimed at a trifling cost. Furthermore the file is capable of being sharpened in this manner from four to six times. The device is a comparatively small one, somewhat like a forge in appearance, and having a hood. Under the latter is a rack for holding the file which is to be operated upon. The jet, which may be air or steam, or a combination of both, is laden with some abrasive and it strikes the file at an angle of from fifteen to thirty degrees. In this manner the blast acts upon the back or sloping edge of the teeth. The abrasive material falls into a pocket containing water and is drawn from this receptacle and used over and over again until it becomes broken up into such fine particles that it floats off in the overflow of water. The cost of this renewal is said to be one-tenth that of a new tool. Hack-saw blades may be successfully treated in the same manner.

A HANDY PORTABLE CRANE AND HOIST.

BY A. FREDERICK COLLINS.

A utility tool that has been found almost indispensable in garages, machine shops, and warehouses is the portable crane and hoist shown in the accompanying illustration. This crane is constructed of angle steel bent to the required form without a joint from top to bottom, effectually eliminating all the weak points of previous types. It rests on three wheels, each of which is 7½ inches in diameter with a 3-inch face, and these form the truck on which the bed of the machine rests; the wheels are about 4 feet apart at each angle. The sheaves at the head of the crane are on a cold-rolled shaft, and midway between the head and the windlass is placed a roller, over which the cable draws leading to the windlass. The crane is usually furnished with a special grade of manila cable, the tensile strength at breaking limit being 2,400 pounds. The smallest size is equipped with three ropes from the overhang to the steel pulley block; the next largest size has five ropes, the third seven ropes, and so on. Chain hoists can be used instead of the manila cable, and an adjustable grab chain having two double hooks for handling cases, casks, barrels, etc., can be used where necessary. The crane is made in six sizes, the smallest weighing 260 pounds and having a lifting capacity of 1,000 pounds, while the largest weighs 650 pounds and lifts 6,000 pounds.

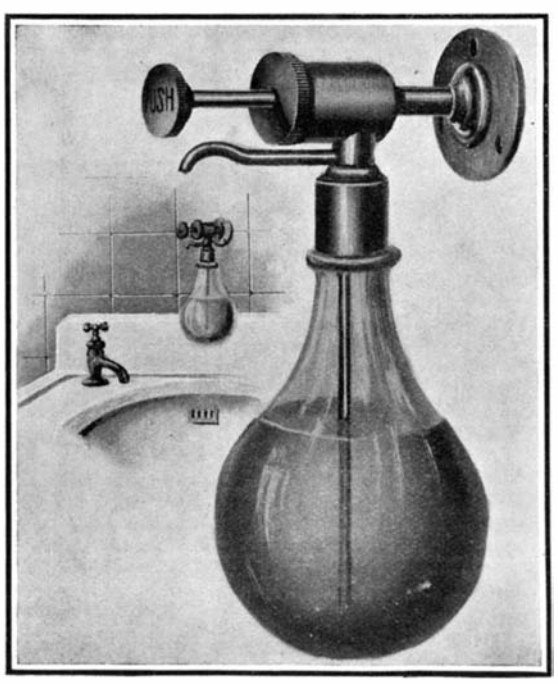
The advantages of this hoist are readily apparent when its portability is considered; it can be easily rolled to the desired position, and one man can handle armatures, lift an engine out of a chassis, or heavy castings on or off machine tools; in fact, the apparatus will perform many of the duties of an overcrane or a trolley truck, thus saving the large cost of installing the latter equipments.

A manufacturer of automobiles has called this crane "the handiest man in the shop;" and this is quite true, for it circumvents the necessity of keeping several men waiting for a ponderous crane to do a little work, and no other tool will pick up and carry heavy weights to where they are wanted, and then get out of the way, hence it is a tool that keeps things moving.

A HANDY PORTABLE CRANE AND HOIST.

LIQUID SOAP HOLDER

Physicians have often pointed out the dangers of using cake soap in public lavatories. Good soap, undoubtedly, possesses antiseptic qualities of a mild character, but it is unable to cope with the germs of a virulent disease, and, as a consequence, it often plays an important part in communicating contagious diseases from one person to another. With the purpose of overcoming this evil, and insuring a clean supply of soap, the soap holder shown in the accompanying engraving has been invented. It consists of a bottle in which soap in liquid form is contained. Screwed to the neck of the bottle is a plug, which supports a piston cylinder. The plug is formed with a port, which opens communication between the rear of the cylinder and the interior of the bottle. A tube in the bottle, which reaches almost to the bottom of the receptacle, passes through the plug and communicates with a spout. The plunger, which fits snugly into the cylinder, is normally held in the outer position by means of a coil spring. The outer end of the plunger is fitted with a push button. The cylinder is formed with a bracket, by means of which the device may be readily fastened to the wall or other support over a basin. In use, the push button is pressed, compressing the air in the bottle and forcing some liquid soap up through the tube and out of the spout. The operator may be assured that the soap is perfectly clean, as there is no way in which it may be contaminated. Aside from the value of this device, in preventing the dissemination of disease germs, it prevents an undue waste of soap, for, as is well known, more soap is wasted, when used in cake form, than is actually put to use. When the supply in the receptacle is exhausted, the bottle may be unscrewed and refilled without necessitating the removal of the piston cylinder and bracket from the wall. Not only can this device be used for dispensing soap, but it will be found equally useful for various toilet preparations. A patent on this liquid soap holder is owned by the Bender Manufacturing Company, Land Title Building, Philadelphia, Pa.



LIQUID SOAP HOLDER.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

HOSE-SUPPORTER.—J. MANN, New York, N. Y. A waist band carries three flaps, one fixed the others adjustable. Each outside flap carries a depending tape and an intermediate flap carries two tapes, all tapes being preferably made of elastic material and provided at their lower extremities with buckles and clasps. Buttons preferably of the ball-and-socket type are arranged on the three flaps for connecting them together when the entire supporting strain is thrown at the front of the body and to be disconnected when the supporting strain is to be partly distributed at each side.

TRUSS ATTACHMENT FOR CORSETS.—I. BAER, New York, N. Y. In this patent the invention relates to trusses such as worn by ruptured persons. The object is to provide a truss which may be readily attached to a corset and which will carry an adjustable pad adapted to the different kinds of rupture with which persons may be afflicted. While the truss attachment is expected to be used largely by women, a modified or skeleton corset may be used where the device is to be used by men.

Of Interest to Farmers.

AUTOMATIC PITCHER AND SELF-FEEDER FOR THRESHING MACHINES.—G. C. WILES, Hutchinson, Kan. The improvement relates to threshing-machines, and concerns itself especially with the construction of mechanism for feeding the unthreshed grain to the cylinder. The object of the invention is to produce feeding mechanism which will enable a quantity of grain lying within a given radius to be fed quickly and automatically to the machine.

ADJUSTABLE REEL FOR HEADERS.—R. H. ACKERMAN, Endicott, Wash. The headers have above a row of teeth a reel for bringing the heads of grain up to the stripping-teeth, and this reel is required to be made adjustable up and down in relation to the teeth to accommodate grain of different height as well as to cut in hollows and on uneven ground. This adjustment should be made with one hand without stopping the team, and the invention provides a convenient mechanism for doing this.

WEEDER.—A. MCRAE, Pendleton, Ohio. The blades are set so that they cut just beneath the ground, and should one become clogged the blade may be lifted from the ground by means of the attached lever, while the other remains in place. The blades may be used alternately, thus preventing clogging of the weeder. Means are provided by which the blades during elevation are moved rearwardly at slight angle with respect to the ground and after freeing from the ground move quickly upward in position for quickly freeing them from the accumulated weeds, etc. When in the upward position, the arch of the arched arms is almost directly upward, thus allowing all accumulations to fall easily therefrom.

DUMP AND ELEVATOR.—J. F. COLLINS, Marcus, Iowa. The objects of the inventor are to provide a combined dump and elevator adapted to unload and elevate the contents of a wagon by means of a team while attached to the wagon and to provide means for enabling the device to be used in narrow passageways and between cribs, so as to carry grain to many different cribs or bins without removing the machine or using a drag.

MACHINE FOR HULLING GREEN CORN.—W. CALDWELL, Circleville, Ohio. One purpose of the improvement is to provide an effective machine especially adapted for removing the hulls or skins from green corn after the corn has been cut from the cobs, whereby to provide a more superior quality of food product than the ordinary canned, evaporated, or dried corn.

Of General Interest.

PROCESS OF MAKING A SOLUTION OF OXYHEMOGLOBIN.—W. J. J. HENDRIKSZOON, Hague, Netherlands. The method used in this process permits the complete recovery of all the hemoglobin from the blood-corpuscles without the use of any ether, which latter was hitherto necessary to the known methods. The complete extraction of the hemoglobin or the oxyhemoglobin is effected in the simplest manner and, moreover, renders possible the complete separation of the stroma.

VALVE.—C. D. BALLARD, Elgin, Ohio. The cylinder of oil-wells usually contains two valves. The bottom or "standing" valve is stationary and coacts with an upper reciprocating valve in raising the oil through the well-tube to the surface of the ground. It is often necessary to remove these valves to renew the leathers, etc. These operations require considerable time and delay, as well as work, which it is the object of this invention to overcome.

PENCIL-HOLDER.—S. J. LESTER, Otter Pond, Ky. The object had in view in this case is the provision of a device which shall not only be novel and useful, but adapted to hold a series of pencils penholders, or similarly formed instruments, and at the same time be constructed providing ready attachment and detachment of the holder from the article of apparel such as a coat, shirt, etc.

FLY-TRAP.—J. O. WINDUST, Walker, Wash. The fundamental principle of construction is embodied in a hood or petticoat which by a clock mechanism is intermittently raised and dropped over a board or table baited with sugar or molasses, the flies being thereby caught in a temporarily-darkened chamber, whence they emerge through a lighted opening into a receiving-cage.

WALL-PAPER.—J. J. JANEWAY, New Brunswick, N. J. The object in this instance is to provide a border or ceiling in a continuous roll with blank fillings for the places eventually to be left open, thus giving sufficient strength or reinforce to the paper and permitting of free handling and rolling of the paper without danger of tearing the junction-lines between the blanks and the pattern being perforated, so that the blanks may be readily removed before the border is placed in position.

AUTOMATIC CUT-OFF.—H. J. TRAH, Logansport, Ind. This invention has reference to water distribution; and its object is to provide a cut-off designed for use in house-leaders and the like and arranged to allow the dirty rain-water from the roof of a house to pass to a waste-pipe and then direct the following clear rain-water to a cistern or other reservoir.

CURETTE.—E. REAVLEY, Rosthern, Saskatchewan, Canada. The purpose is to so construct this instrument that it will be of semi-pliable material, and so that one shank and handle can be fitted to different sizes of the instrument, and, further, to provide an instrument that may be safely inserted without injury, and which will act to remove placenta or other fetal matter and substances without lacerating or inflaming intra-uterine tissue and without danger of producing new lesions and which will be much superior to metal instruments now used or the finger of the operator.

Hardware.

SAW-FRAME.—A. ALLEN, Lead, S. D. This invention refers especially to that class of frames for receiving a detachable blade. The object is not only to improve the construction of saw-blades of this character, making them more convenient to handle, cheapening and simplifying them, but also to provide a novel and easily-operated means for stretching the saw-blade in the frame after it is applied thereto.

CARPENTER'S TOOL.—B. STOLL, Gardena, N. D. The invention pertains to woodworking-tools. and its object is the provision of a new and improved carpenter's tool more especially designed for pressing floor-boards, sheathing-boards, and the like into proper position for nailing. It is very simple and durable in construction and can be cheaply manufactured.

MAGNETIC TACK-HAMMER.—J. A. R. DAMONTE, New Orleans, La. In this magnetic tack-hammer the tacks are placed in the magazine indiscriminately, and when the hammer is brought up to a striking position it causes the tacks to scatter, and on the outward swing or striking movement they find their way one at a time through the tube and slot in the handle and down into the slideway.

BOLT-EXTRACTOR.—W. MCCORMICK, Hillyard, Wash. This bolt-extractor is designed, primarily, for the removal of crown-bolts from the crown-sheets of locomotives, although its use is not limited to this particular class of work, since it will be found to be an effective means for removing bolts in other relations, especially those with round or other forms of heads on which an ordinary type of wrench cannot obtain a purchase.

NUT-LOCK.—D. W. PATTON, Moberly, Mo. In use the nut is screwed on the bolt the distance desired and turned so that the flattened end of the bolt lies parallel to the grooves in the nut. The staple is inserted in the grooves, thus holding the flattened end portion of the bolt between the two arms thereof and preventing its rotation. Means are adapted to engage the edges of the nut and prevent accidental displacement of the locking member. The latter being preferably of wire, its outer ends may be bent out of alinement after its insertion, thus serving as an additional means for holding the same in place.

Heating and Lighting.

HYDROCARBON-BURNER.—J. N. BLAIN and O. H. SMITH, Ottawa, Kan. The object of this invention is to produce a burner which will present efficient means for carbureting the air let into the burner. A further object is to construct the fire-pan so as to enable the same to be readily inserted in an ordinary stove or furnace and to provide the same with special means for facilitating the gasifying of the fuel when fed thereto.

Household Utilities.

WATER-CLOSET TANK.—F. W. KINGSBURY, Evansville, Ind. Mr. Kingsbury's invention is an improvement in water-closet tanks, and has for its object to provide novel means for supporting the tank and for holding it by the plumbing connections in interlocked engagement with the supporting means. The construction dispenses with the expensive and objectionable back plate or board and brackets ordinarily employed.

MATCH-HOLDER.—M. JAEGER, New York, N. Y. The object in this case is to provide a device that may be attached to a wall or similar support and adapted to hold a full box of matches and so constructed that the matches will automatically feed downward to be removed one at a time, thus preventing waste of matches and obviating danger from fire by matches falling on the floor and igniting by a person's shoes.

BABY-WALKER.—H. VOIGT, SR., Winona, Minn. The purpose in this improvement is to provide a device usable in a house or out of doors, it being sufficiently strong in construction as not to be damaged by out-door exposure and by means of which a child learning to walk will have healthful exercise and amusement. It may be compactly folded when not in use.

WATER-CLOSET SEAT.—F. W. KINGSBURY, Evansville, Ind. In this instance the invention is an improvement in water-closet seats, and has for its object the provision of a seat which will present no unusual appearance, will be strong and durable, and will have no sockets or other openings in its exposed faces to be filled by putty, litharge, cement, or the like.

COMBINED DRESSING-TABLE AND CLOTHES-PRESS.—H. KNAPP, Springfield, Mass. In the present patent the invention has reference to cabinets; and the object of the improvement is the production of a cabinet which will constitute a combined dressing-table and clothes-press, which cabinet will be of simple construction and ornamental in appearance.

Machines and Mechanical Devices.

THREAD-LUBRICATING DEVICE.—C. H. EMERSON, New York, N. Y. The invention pertains to a device for waxing thread, and is especially applicable for use on spooling-machines, where it is mounted at such a point that the thread in passing to the spooler may pass through the device in order to be waxed. It is designed for the reception of a solid lubricating material in lumps—as, for example, paraffin or the like.

COTTON-GIN-CLEANING DEVICE.—F. H. TAYLOR, Kansas City, Kan. Mr. Taylor's object is to provide means for cleaning the saw-cylinders of cotton-gins of the gummy matter which accumulates thereon under some conditions. He attains this end by a rubbing device, which may form a permanent part of the gin or a temporary attachment thereto, and which when thrown into action alternately scrapes or rubs the sides of the saws, rapidly and effectively removing the accumulations thereon.

ADDRESS-PRINTING ATTACHMENT.—W. L. BUCKSEN, Blooming Prairie, Minn. For each operation of the press a wheel is rotated one step, and the parts are so designed that this provides for printing one name and moving the next type into a position where it can perform the printing operation the next time the drum rotates. The ink is applied to the types in a convenient place, and they are cleaned on a felt pad in an effective manner.

ORE-SEPARATOR.—M. R. LYLE, Oakland, Cal. The device is especially adapted for effecting the separation of gold from its ore or from gold-bearing sand and gravel. The object is to provide a construction by means of which as the separation of the metal is effected the waste material will be constantly ejected. Means provide for reducing the forces to operate the device and to provide an arrangement which will prevent loss of metal in the waste sand.

YARN-PRINTING MACHINE.—W. E. LYFORD, Thompsonville, Conn. The machine is such as is used by carpet manufacturers in making tapestry and other carpets, rugs, and like fabrics. The object of the inventor is to provide improvements in yarn-printing machines whereby a proper and intense rubbing or scraping of the color is had to insure a thorough penetration of the color into the yarn, thus producing a printed yarn of high quality.

SEPARATOR.—W. M. COOK, Ludlow, Vt. The invention relates to grinding-mills and the like reducing-machines for reducing dry substances to powder; and its object is to provide a separator arranged to insure a thorough and complete separation of the tailings from the finished product in a comparatively simple and inexpensive manner.

AUTOMATIC SELLING-MACHINE.—W. ABEL, 9 Lutherstrasse, Berlin, Germany. By means of this device complete security is obtained against the taking out of more cards than one or when layers of two or three cards each are placed crosswise one upon the other against the taking out of more than two or three cards, respectively. At the same time it is effected that the pile of cards is not supported only in the margins of the cards, but rests on the whole surface of the latter, and that the card to be pushed out rests flatly between the remaining pile of cards and a flat supporting-plate and can be shoved out, moving in its own plane.

PILE-FABRIC LOOM.—F. A. WHITMORE, Philadelphia, Pa. The object of the present invention is to provide a new and improved loom for weaving pile fabrics. To produce the weave a special heddle device is used. The invention is so arranged that the pile warp-thread is looped around a lower ground warp-thread and then passed between ground warp-threads and these latter are twisted between successive picks, so that certain members of a pile extend on opposite sides of the upper ground warp-thread.

MULTIPLE-DRILL SOCKET.—J. P. HYLANDER, Portland, Ore. The purpose of the invention is to provide a socket in which three or more drills may be held and simultaneously operated. Means are provided for adjusting the relative positions of the drills and for adjusting the socket for different lengths of drills.

Railways and Their Accessories.

SAFETY DEVICE FOR AIR-BRAKES.—J. JUDGE, Pittston, Pa. The invention pertains to means for applying the air-brakes to the cars of a train, and has for its object to provide a device not liable to become inoperative, and adapted to insure proper observance of a danger or other signal designed for the engineer.

RAIL JOINT.—T. BOWEN, Grove City, Pa. In this instance the improvement refers to rail-joints for securing together the meeting ends of railway-rails, and has for its object to provide means adapted to clamp the ends of the rails firmly and hold them evenly together at all times, thereby preventing the ends of the rails from sagging and becoming worn by the consequent pounding of cars passing over them.

TRAIN-SIGNAL.—G. D. WATSON, Parkersburg, W. Va. In applying the invention signal-posts are provided at suitable points, and between these posts a plurality of intermediate posts are set, and these support wires, so that a fence or guard is formed adjacent to the track and on the side where dangers from landslides are expected. If a landslide occurs the movement of the earth or rocks will operate the wires and release a semaphore, which will then descend into the danger position. The apparatus may be made useful at night as well as in daytime. The invention is applicable in preventing accidents from a cave-in at a tunnel. It may prevent an accident from the lateral shifting of a track. It may also be used to prevent an accident from the destruction of a bridge. The signal will be operated not only by a pull in the wires of the guard-fence, but also by a rupture or breaking of these wires.

Pertaining to Recreation.

SWIMMING-MACHINE.—J. STUB, New York, N. Y. An embodiment of this invention consists of a frame of tubular construction having a pointed forward end between which is fixed a float comprising a hollow body conforming to the frame and which is shaped like a cigar. The machine is provided with a keel fixed to the float to prevent it from overturning and also provided with suitable propelling means journaled in the rear end of the frame.

TOY WAGON.—W. SLATTERY, New York, N. Y. This novel arrangement to interest and amuse the young, consists of a four-wheeled structure having vertical standards adjacent to each wheel, on which are journaled spools or reels adapted to be driven from the periphery of the wheels and also themselves driving ornamental spinning devices in an elevated position.

SPRING FISH-HOOK.—A. S. MARTIN, Geneseo, Ill. The invention relates to hooks of the type in which a spring-actuated auxiliary hook is released when the fish strikes at the bait, thus allowing a plurality of hooks to obtain a firm hold upon the fish, and thereby prevent its escape. The device is especially useful in the catching of quick-striking fish, such as trout or bass. The hook is only operated by actual contact.

Pertaining to Vehicles.

VEHICLE-WHEEL.—T. T. CHALONER, New York, N. Y. The object of the inventor is the provision of a yielding tire of novel construction that may be placed on a wheel having a metal tire and serve as a substitute for a penumatic tire and having all the yielding qualities thereof without the danger of destruction by puncturing or wear. The invention may be applied to a wheel having a pneumatic or a solid-rubber tire.

SPEED AND DISTANCE INDICATOR FOR VEHICLES.—C. R. JOHNSON and C. KNOFF, New York, N. Y. The invention pertains to improvements in devices designed to be attached to vehicles, particularly automobiles, to indicate the speed of travel, the miles covered in a single run, and the total number of miles traveled, the object being to provide a device that will be simple in construction and accurate in operation.

BICYCLE-LOCK.—S. HAYFORD and K. HAYFORD, Turtle Bayou, Texas. In this patent the object of the invention is to provide a bicycle-lock which forms a permanent fixture of the bicycle, is completely out of sight, and arranged to lock the running gear of the bicycle to prevent unauthorized persons from riding away with the bicycle.

Designs.

DESIGN FOR A LAPEL-BUTTON.—A. JOHNSON, New York, N. Y. Mr. Johnson has invented a new, original, and ornamental design for a lapel-button, comprising a round, flat button placed in the center of two crossed oars. It is very neat in appearance.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

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(10296) Y. M. C. asks: Please give recipe for solution to oxidize nickel. A. To oxidize nickel, place the article for a short time in a dilute solution of potassium sulphide, sodium sulphide, or ammonium sulphide.

(10297) L. T. says: We have a number of kerosene barrels filled with water on top of our buildings, to be used in case of fire, and during the winter are troubled considerably by the water freezing and bursting of barrels, although we put in one or two pails of salt as a preventive. We have been informed that people were in the habit of standing a piece of 2 x 4 pine on end in a barrel of rain water to prevent the bursting of the barrel. Would like to know the best preservative to use for preserving the barrels against the effect of exposure to the sun and elements. A. If the barrels are open in one end, there should be no bursting or freezing, as the expansion is not hindered. There would be no use in putting in a piece of pine wood. Salt is of use, but will not prevent freezing in extremely cold weather. Paint with asphalt to preserve the barrels against the effect of sun and rain; with good asphalt the life of such a barrel becomes almost indefinite.

(10298) F. A. S. asks for a strong glue that can be held over a flame and then be applied. A. Some of the so-called marine glues are used in this way: (A) Naphtha, 1 pint; pure rubber, cut into shreds, 1 ounce. Macerate for 10 to 12 days and then rub out smooth on a plate. Then mix 2 parts of shellac with 1 part of this solution. Melt at about 250 deg. F. for use. (B) Dissolve 10 parts of caoutchouc in 12 parts of refined petroleum, by digesting for 10 days to 2 weeks. Then carefully melt 20 parts asphalt and when melted, pour in the other solution. Keep warm (in hot water), and stir until uniform. Pour into greased molds and allow to harden. These marine glues are very strong.

(10299) G. H. M. asks: Can a battery be made where one of the electrodes used is gold? If so, what is the other electrode, and what is the exciting fluid used? A. We can see no reason why a battery may not be made with gold for a negative element, and any metal which will be acted upon by the liquid used for the positive element, if one wished to do so. Platinum was used in this way in some of the older forms of cell. It was replaced by carbon as a cheaper material. And the carbon of almost any cell may be replaced by gold.

(10300) J. M. C. asks: How many watts are required to 16 candle power incandescent lamp per hour? Also, about the average price per thousand watts of electricity. A. Incandescent lamps for best service are made for about 3½ watts per candle, or 55 watts for a 16 candle power lamp. The price for service is differently rated in different places. In large cities it is about 2 cents per ampere hour at 110 volts; in small places the rate is often so much a lamp-month, the time of lighting not being considered.

(10301) C. B. says: I want a magnetic coil capable of attracting an armature a distance of ¾ of an inch. The circuit will have a pressure of 110 volts at 10 amperes. What size coil will I need, and also size wire? A. We do not advise you to make a magnet as you propose to carry 10 amperes at 110 volts pressure for the purpose of attracting an armature ¾ of an inch. It would require a large wire and be very heavy. It is far better to use one ampere and have a pair of 100-volt lamps in parallel as a resistance. The coil will require to be wound to 10 ohms resistance and No. 24 wire may be used. Of this about 400 feet will be required.

(10302) C. S. N. writes: 1. Having noticed in your Notes and Queries column a short time ago that borax and good management are the best for welding steel, I wish to state that while both are indispensable. I find that an ounce of carbonate of iron to the pound of borax is a very good addition. Can you inform me whether aluminium can be soldered with lead-and-tin solder, and in what proportions? Also, what kind of acid to use? A. Lead-and-tin solder alone is not suitable for soldering aluminium. A solder made of 1 part aluminium, 1 part of 10 per cent phosphor tin, 8 parts zinc, 32 parts tin, by weight, makes a good-flowing solder. Canada balsam is used for flux. 2. What is the voltage of an Edison-Lalande battery cell, such as is used on gasoline engines, and will it be either temporarily or permanently exhausted by running a small motor for an hour or more? A. The voltage of an Edison-Lalande cell is about 7-10 volt. Their small internal resistance greatly increases their amperage and capacity to from 100 to 300 hours. They are not exhausted on short runs.

(10303) C. E. D. writes: In a recent issue G. M. T. asks concerning the falling of two spheres of same size but different weight, and you reply that they will fall in a vacuum with the same velocity, likewise the same in air. The latter part of the answer is manifestly incorrect, for it would indicate that falling bodies are not resisted by the air. The weight of the body is the power to overcome the resistance; and since the resistance is the same, the heavier body will fall faster. Any other conclusion will not produce added speed. A. We fear our answer to the query was not sufficiently explicit. Two bodies of the same size but of different weights will fall with different velocities in the air after they have fallen a sufficient time. Aluminium is more than 2,000 times heavier than the air at normal pressure. At or near the beginning of its fall the air would resist an aluminium ball in the same degree as one pound would resist the motion of a ton. How slight that would be any one can see. It would be imperceptible under moderate velocities. How little the air resists heavy dense bodies can be seen by considering how swiftly a stone or bullet cuts the air. Lead is more than 8,700 times heavier than the air, and is in a higher degree able to overcome the resistance of the air. There is no question that the lead ball will acquire the greater velocity. The height from which the balls are dropped must be greater than is usually available for such experiments in order to make this difference appreciable. Our correspondent is quite right in his argument, and the result will be as he says if there is a sufficient distance for the fall. It will probably be necessary to drop the balls from a height of about 200 feet to make a perceptible difference in the time of fall.

(10304) C. H. asks: Please publish in your Notes and Queries column directions for constructing a Wimshurst static electric machine capable of producing a half or three-quarter-inch spark. A. You will find full instructions with working drawings for making a Wimshurst machine in our Supplement 548. Other valuable articles are contained in Supplements 584, 647, and 648, which we send for ten cents each. It is not our practice to print again what we have already published, but to refer inquirers to the proper numbers, in which they can find what they require.

(10305) A. C. B. says: Please settle the following argument: A says that a wheel coming in contact at its bottom surface meeting with resistance will speed faster at its upper surface than at point of contact. B states speed is identical at both points. A. A rotating wheel of any sort turns about its center, so that all the parts of the rim move with the same velocity, that is, while one point turns through five degrees of a circumference, every other part turns through five degrees. This must be evident, since the wheel does not break apart, as it would do if one point went faster than any other point. But if an eye were on the surface of the ground just by the side of the rim of the wheel as it turns to that eye, a point of the rim would seem to come down toward it and come to rest by the side of the eye, instantly that point of the rim would move again and rise up into the air to the top of the wheel. To such an eye the point of the wheel in contact with the earth is at rest. In your discussion A sees one feature of the motion of a wheel and B sees another feature, and both are right, for the wheel has both motions at the same time. We wish this question might come to rest *in the ground.* Some one asks it nearly every month. See answer to Queries Nos. 9622, 9636, 9679. Every possible feature of the motion of a wheel is considered in one or another of these answers.

(10306) E. E. L. asks: 1. Would like to make inquiry as to the probable number of the earth's magnetic lines of force per square inch passing over the earth's surface at the equator. A. We have not the figures at hand for intensity of the earth's magnetism at the equator. You can perhaps obtain them from the Director of the U. S. Coast and Geodetic Survey, Washington, D. C. 2. What is the boiling point of chemically pure water in vessels of the different common metals, and also in an earthenware vessel? A. Pure water boils at 100 deg. C. when the barometer stands at 760 millimeters, and the thermometer in the open air is at the freezing point. We are not aware that the containing vessel has any effect upon the boiling point of a liquid contained in it. 3. What is the temperature at which an electro-magnet ceases to be magnetic? A. Iron ceases to be magnetic at a red heat. 4. Is it possible to insulate a flowing stream of water, as from a hose, so that an electric current will not flow to the earth? A. Water, pure water, is an insulator of itself, and a current of electricity cannot flow along a stream of water from a hose discharging pure water. Atmospheric electricity or electricity of very high potential will discharge over an insulator, as does lightning, and Leyden jars, and waves from wireless telegraph transmitters; but hydrant water does not to any great extent carry the electricity of 110 volts such as is used on lighting circuits. We are aware that the popular impression is quite different from this. We do not know how to insulate a hose at its nozzle when the other end of the hose is attached to the earth.

(10307) W. L. J. asks for an acid-proof cement, preferably one which will stand a reasonably high temperature. A. Try a putty made of litharge and glycerin.

(10308) L. A. D. writes: I am a stereotyper. What will I put in paste to make the matrix hard after it is dry? Give me a recipe for backing powder. What is the cause of blow holes in plate and cure for it? A. Paper matrices for making stereotype plates from type forms, used in newspaper offices, are prepared as follows: Make a jelly paste of flour, starch, and whiting. Dampen a sheet of soft blotting paper, cover its surface with the paste, lay thereon a sheet of fine tissue paper, cover the surface with paste, and so on until four to six sheets of the tissue paper have been laid on. The combined sheet thus made is then placed, tissue face down, upon the form of types, which are previously dusted with whiting, and with a brush driven down upon the types and thereon allowed to dry. The operation of drying is facilitated by having the types warmed by placing them upon a steam-heated table. A blanket is placed over the paper during the drying operation. Probably thorough drying will avoid the difficulty you mention.

(10309) W. S. S. asks for a recipe for a soap to clean woodwork that will not injure the finish or varnish or paint, but at the same time remove the dirt. Also if such a soap will do the work, should like it for cleaning carpets or rugs, so that same will not be left sticky and stiff. Understand there are receipts for such soaps. A. To clean paint, provide a plate with some of the best whiting to be had; have ready some clean warm water and a piece of flannel, which dip into the water and squeeze nearly dry; then take as much whiting as will adhere to it, and apply it to the painted surface, when a little rubbing will instantly remove any dirt or grease. After which, wash the part well with clean water, rubbing it dry with a soft chamois. Paint thus cleaned looks as well as when first laid on, without any injury to the most delicate colors. It is far better than using soap, and does not require more than half the time and labor. To clean paint, take 1 ounce pulverized borax, 1 pound small pieces best brown soap, and 3 quarts water; let simmer till the soap is dissolved, stirring frequently. Do not let it boil. Use with a piece of old flannel, and rinse off as soon as the paint is clean. This mixture is also good for washing clothes. This would probably answer for cleaning rugs.

(10310) J. H. W. asks: Can you tell me in your query department what is the best size wire for the secondary winding of a spark coil for a gas engine? Could the secondary wire be too fine? Have you a good book on the subject? A. Very rarely is any number of wire less than No. 36, A. W. G. silk covered, used in the secondary of induction coils. The secondary cannot be too fine. We recommend upon this subject Norrie's Induction Coils, price $1 by mail.

(10311) A. M. L. asks: Kindly inform me through the Scientific American: 1. What substances best conduct sound? A. If by best conductors is meant those through which sound travels most rapidly, the answer as given in Zahm's "Sound and Music," price $2.50 by mail, is steel, 15,470 feet per second; iron, 16,822 feet; fir wood, lengthwise the fiber, 15,218 feet; aspen wood, along the fiber, 16,677 feet; white pine, 17,260 feet. Chladni obtained a velocity for fir much greater than that given, 19,685 feet. 2. What substances are most opaque to heat? A. Kent's "Engineers' Pocket Book," price $5, gives as the result of tests with heat at 310 deg. F. a list of 32 articles, of which the best four are loose wool, live geese feathers, loose lampblack, and hair felt. Of course these are all combustible, to an extent. Of covering materials, for instance, to protect ice from melting, mineral wool and hair felt are the best. In protecting liquid air from external heat to prevent evaporation a vacuum as perfect as possible has proved to be the best insulator. 3. What substances are most incombustible? A. A brick is probably the most incombustible thing. It has been once burned in a kiln till everything combustible in it is destroyed. Volcanic lavas are also incombustible. Furnace slag is of the same character.

(10312) J. M. C. asks: How many watts a 16-candle-power incandescent light will use? A. Sixteen-candle-power lamps of different types use from three to four watts per candle.

(10313) H. W. C. asks: Please advise me as to what books you recommend on designing of motors of the two-pole Edison type, with points as to effect of change of area of poles, position of greatest pull, etc., price of same and where to be had. Will Parkhurst's $1 work cover it? A. For the principles of designing of motors on direct current we recommend Thompson's "Dynamo Electric Machinery," price $6, as the leading authority. Hawkins and Wallis's "Dynamo," price $3, discusses the principles of the machine. Wiener's "Designing of Dynamos and Motors," price $3 last edition, is considered a reliable work. Parkhurst's little book, price $1, contains the plans and details of two little motors which he designed. It has no instruction in reference to the mode of designing. The book "Electrical Designs," price $2, contains a large number of plans of machines, some of which would probably be useful to you. The only way to learn the art of designing thoroughly is to take a course of electrical engineering and then work in the shops of some one of the great electrical companies. You will then become a designer with originality in your designs.

(10314) K. G. B. asks: 1. Will you kindly inform me through your valued paper whether there is any way of finding the "constant" of a Thompson recording wattmeter from the type, class, etc., as stamped on the metal plate attached to it? To illustrate: What would be the constant of a Thompson wattmeter Type M, Form E 3, Class 50, 220 volts? The constant of these meters is always marked in ink, which makes it easy for electric light companies, if they are inclined that way, to change it to a higher figure, thus making the meter register more current than is consumed in reality. A. The constant of a Thompson recording wattmeter may be roughly verified by the following method: Turn on a number of lamps of a rated number of watts. Multiply the watts per lamp by the number of lamps. Observe the number of seconds required for a revolution of the disk, and multiply the watts used by the number of seconds per revolution of disk. Divide this product by 3,600, the number of seconds in an hour. The quotient is the constant required. If a stop-watch is used the seconds per revolution can be found with great accuracy. The reason this is only a rough method is that lamps as they grow old take more than their rated number of watts. The meter is not liable to over-record the service, since the disk is not likely to run too fast. A better way is to connect an accurate wattmeter in series with the recording meter to be tested, and compare the readings. 2. Is there any book or manufacturer's catalogue that will give accurate information on this subject? A. Foster's "Electrical Engineer's Pocket Book," price $5 by mail, and the circulars of the manufacturers.

(10315) H. H. asks: Kindly advise me of the method used for grinding glass for the mirrors of reflecting telescopes; I mean more particularly the means of describing the curve before beginning. Also, if there is not a more practical way of getting a parabolic curve than that given in most text-books, which simply say it is the focus of a point equi-distant from the focus and directrix? I understand the theory well enough, but often wonder if opticians have no more practical way of getting at it than constructing perpendiculars to the directrix and measuring to the focus; also, if in getting at a spherical curve of, say fifteen feet radius, it would be necessary to use a compass or stick of that length to construct it? If you know of any publication that would give me this information will you kindly let me know of it? A. A parabola is most correctly described by locating a sufficient number of points on the curve and passing a line through these points. Kent's "Engineer's Pocket Book," price $5, gives four methods of describing a parabola. In shops, the curves required are first described of full size and a template is made for use in work. Lofts or floors of sufficient size are necessary. For grinding lenses, forms are turned and used in the machine or by hand to shape the glass. Orford's "Lens Work for Amateurs" gives instructions in this work.

(10316) N. J. R. asks: What are the proper proportions of gas and air to use for the greatest explosive force of acetylene, gasoline, and crude oil gas? A. The strongest explosive power of acetylene gas is made by a mixture of 1 part acetylene to 9 parts air; of gasoline vapor, 1 part vapor to 8 parts air; crude oil illuminating gas, 1 part gas to 6 of air. See Hiscox's book on "Gas, Gasoline, and Oil Engines," $2.50 by mail.

(10317) D. P. asks: A says that the mechanical advantage of a movable pulley is due to the fact that it is a second-class lever. B says that the mechanical advantage is in the rope. A. The movable pulley is a second-class lever and the source of power. The rope is only the medium of its application. A is correct.

(10318) F. H. asks: 1. I have a yoke and cores for an electromagnet. Yoke, 8 by 1½ by 1¾ inches; cores, 6 by 1 inch. I have at my disposal six large bichromates. What number of B. W. G. should I use, and how many pounds of the same to obtain the best effects in connection with my battery? A. Use No. 14 magnet wire, and wind to a depth of one inch on the spools. You will find in the new edition of Hopkins' Experimental Science, price $5, full directions for such a magnet. 2. Also if such a magnet could be used for diamagnetic experiments? A. Yes; with pole pieces properly shaped to bring the flux to the point where the diamagnetic substance is suspended. These, too, are illustrated in Hopkins. 3. Please give me the best proportions of water, bichromate of potash and sulphuric

acid for bichromate cells (water and acid in cubic centimeters and bichromate in grammes). I have several recipes, but they all differ with regard to proportions of bichromate and acid. A. There are many formulas for the bichromate solution. We cannot say which one is the *best*. Practice now is to use chromic acid directly in place of bichromate of potash. Indeed, bichromate of soda is to be preferred to the potash salt, since it is more easily dissolved and the solution does not throw down crystals, as bichromate of potash does. The idea is to have a saturated solution of the salt and add sulphuric acid to a proportion of about one in ten to one in twelve. If the acid is more than one in ten it will act too strongly on the zincs and the cell will overheat, the liquid "boiling" as it is called.

(10319) W. M. H. asks: 1. May the direction in which the armature of a dynamo or motor revolves be governed at the will of the operator by change of current or other means? A. A dynamo may be run in either direction by placing the brushes so that they lead in the proper direction. A motor is reversed by changing the direction of the current in either the field or the armature, but not in both. 2. What means is employed to change the direction in which a trolley car runs? A. By throwing the reversing switch to change the current as above.

(10320) W. D. S. says: In your "Scientific American Cyclopedia," under the head of "Soaps," is a formula for making "Yellow Soap," the last of the list of soaps. It gives: Tallow, ½ lb.; sal soda, 1½ lb.; resin, 5 to 6 lbs.; stone lime, 28 lbs.; palm oil, 8 oz.; soft water, 28 gal. Surely this is a misprint. Will you kindly give me the correct formula, as I wish to make a soap with sal soda and lime? Also, could you give me the formula for making bisulphide of carbon for killing gophers and weevil? A. For the manufacture of ordinary yellow soaps, the fats used are tallow, palm oil, and resin. These may be used in such varying proportions that a few general facts will be of more value than one specific formula. Fats require from 13½ to 15 per cent of caustic soda for complete saponification. Rosin also requires about 15 per cent. As caustic soda is more expensive than soda ash (carbonate of soda), it is common practice to take soda ash and causticize with lime. An excess of lime is usually used. One hundred parts of soda ash are dissolved and heated to boiling; 75 to 100 parts of lime are then added, and the boiling continued for about one-half hour. It is then allowed to settle, and the clear solution is used for making the soap. In estimating the amount of soda ash required, it may be assumed that 100 parts of soda ash are equivalent to 75 parts of caustic soda. The proportion of rosin used is extremely variable, in some cases equal amounts of fat and rosin are taken, but this is not considered excessive. For a good laundry soap the amount of rosin may vary from 25 per cent to 40 per cent of the fat taken. Carbon bisulphide is now largely being made in the electric furnace. It could not be manufactured on a small scale. It can be purchased in any quantities at reasonable price.

(10321) A. B. S. says: I am using large quantities of soft zinc from which I make small stampings, leaving about 30 per cent that I am obliged to put into scrap. This scrap is worth to me 4 cents a pound, whereas the new material costs me 12 cents. My idea would be to melt down this scrap that I have and reroll, but in trying this I find that the metal becomes so hard that it breaks in rolling. I presume that during the process of melting, one or more of the component parts passes off in the form of a gas, or perhaps my appliance for melting is not what it should be. I am familiar with the melting of copper and with the various alloys of brass, but this matter of remelting zinc and putting it in shape to stamp properly is something I am unfamiliar with. A. Melt the zinc at the least possible temperature, and pour into heated iron molds so that the cooling shall proceed very slowly. Avoid introducing any iron accidentally into the zinc during the melting, as iron causes brittleness. Adding 0.5 per cent lead makes the zinc more malleable. It should be rolled out at a temperature of 150 deg. C. to 200 deg. C., at which zinc is most malleable; at temperatures much above or below these limits, the zinc becomes too brittle to roll.

(10322) D. J. B. wishes to know what the back pressure per square inch would be in the cylinder of an engine operated by compressed air instead of steam, and where the air is allowed to expand fully in the cylinder before the exhaust valve opens. A. The back pressure at the exhaust of an air motor depends entirely upon the cut-off point and the initial pressure as with steam in principle, but does not follow the same ratio. See Hiscox's book on "Compressed Air."

(10323) F. M. wishes to know the best chemical used to purify acetylene gas. A. First wash with water to remove ammonia. To remove the other impurities, chiefly compounds of phosphorus and of sulphur, the following chemicals have been used: 1. Chloride of lime; unless all ammonia has been removed, nitrogen chloride may form. 2. Solution of cuprous chloride; one liter of this solution will purify 14 to 16 cubic meters of gas. 3. Solution of chromic acid in sulphuric acid; 5½ grammes of chromic acid will purify 1 cubic meter of gas. 4. Paraffin oil or other hydrocarbon oils. Solutions 2 and 3 give the best results. 4, used in conjunction with 2 or 3, increases the certainty of the purification.

(10324) C. F. H. asks: Can you give me any information as to the mixture used in binding coal screenings together that are made into briquettes? A. The best material for binding coal fines into briquettes, and the one most largely used, is pitch. Asphalt has had a limited use. Starch paste, residues from starch manufacture, dextrine, molasses, etc., have been used from time to time experimentally, but are not practicable. Various mineral substances, such as clays, lime, water-glass, etc., have also been proposed, but naturally have the drawback of adding just so much ash. Occasionally, oxidizing materials, such as niter, are added, when it is desired to produce a very quickly burning briquette for the rapid generation of high temperatures.

(10325) M. G. M. asks: 1. With a current of 20 volts and where bare copper wire is used, is there any waste of same current where nothing but dry pine is used for insulation? A. There is always some leakage of current when bare wire is in contact with wood, and even over insulators, especially in wet weather. But in the case above there would not be much leakage so long as the wood is dry. 2. How many feet of No. 36 tinned iron wire like the inclosed has a resistance of 10 ohms? A. Iron has very nearly six times the resistance of copper. No. 36 copper wire has 2.408 feet per ohm. Ten ohms of No. 36 iron wire would be 4.02 feet long.

(10326) S. R. asks for a good receipt for making a reliable fire extinguisher in powder form, one that is easy to prepare. A. For a cheap, dry powder fire extinguisher, bicarbonate of soda will serve; it may advantageously be mixed with 5 per cent to 10 per cent in some powdered mineral, as flint, tripoli, chalk, etc., to prevent caking in damp air. A mixture of *dry* bicarbonate of soda with *dry* sal-ammoniac, and kept in a *dry* place, will do better, as it would yield both carbonic acid and ammonia. In a confined space fire extinguishers of a type similar to gunpowder have proved effective; the object being to fill the room with carbon dioxide, sulphur dioxide, and nitrogen gases, and thus choke the fire. A good formula for this type of extinguisher is niter, 60 parts; sulphur, 36 parts; charcoal, 4 parts.

(10327) W. R. asks what the different gases are which, if introduced into an inclosed arc lamp will turn the color red, green, yellow, blue, etc. A. Colored electric lights are ordinarily produced by coating the globe with an aniline dye, made in alcoholic solution, and mixed with a little varnish. We do not know any gas which could withstand the heat of the arc for any time and which could color the arc. Some color can be imparted to the arc by soaking the carbons in solutions of sodium chloride, strontium chloride, or lithium chloride, and drying them thoroughly before using. The light of the arc itself is so intense that it is very difficult to overcome it with any other colored light.

(10328) H. M. asks: Can you give me information as to what a transformer is and what it is used for? I have been informed that it is much on the scale of an induction coil. If so, can you give me some scale by which to transform a 110-volt current into amperes? A. A transformer changes an alternating current from one voltage to another and from one current strength to another. It cannot change volts into amperes. In that respect they resemble induction coils. An induction coil is a particular sort of transformer, provided with a condenser, interrupter, etc. It is used almost entirely for raising the voltage. 2. Also, please tell me how many volts it will take to each ampere, and a scale of how it should be wound, what size wire to use, and if the fine wire should be used outside or in? A. It is impossible to change amperes into volts. And as to the winding, each one is wound for the work it is to do. There is no general winding.

(10329) G. W. L. asks: 1. What is the most economical method of generating carbonic acid gas—not necessarily pure—in large quantities? A. The commercial sources of carbonic acid, on a manufacturing scale, are as follows: 1. By the burning of limestone. 2. By the action of acids in limestone (calcium carbonate), magnesite (magnesium carbonate), or dolomite (calcium magnesium carbonate). The acid used is sulphuric. This method is used by the manufacturers of bottled effervescing waters. 3. By collecting the carbonic acid gas generated in the fermentation vats of large breweries. This source is largely used in Germany. In addition, the gas coming from many of the natural springs is collected. This practice is also largely used in Germany. 2. Are there any known chemicals, or other substances, that will decompose water, aside from the alkaline metals? A. Besides the alkaline metals, water is decomposed by many of the hydrides and carbides of the different metals. Thus calcium carbides decompose water with the formation of lime and acetylene. Also, vapor of water passed through red-hot tubes of different metals is decomposed into its constituents. Vapor of water passed through red-hot coal is decomposed, with formation of carbon monoxide and dioxide, hydrogen, marsh gas (CH_4) and other hydrocarbons; this is the basis of the industrial manufacture of water gas, which has displaced coal gas in most cities.

(10330) I. D. asks for a formula for bluing iron and steel without heating. A. 1. From our Cyclopedia of Receipts, Notes and Queries: Scour the steel with a small quantity of a strong aqueous solution of soda, rinse in ¼ of an ounce chloride of iron, dissolved in 5 ounces of water, and let it dry; then apply in the same manner a solution of 1-5 of an ounce pyrogallic acid in 1 ounce of water, dry, and brush. Does not wear well without lacquering. 2. The blue oxide is sometimes imitated by using a thin alcoholic shellac varnish, colored with aniline blue or Prussian blue. 3. To blue steel without heat, mix finely-powdered Prussian blue with rather thin shellac; gently heat the steel and apply the varnish. 4. Iron and Steel to Blue Without Heat—Solution of potassium ferricyanide and water, 1:200; solution of ferric chloride, 1:200. Mix the two solutions and dip. 5. Antimony trichloride, 25 parts; nitric acid, fuming, 25 parts; and hydrochloric acid, 50 parts. Apply with a rag and rub until the proper color is obtained with a piece of green oak.

NEW BOOKS, ETC.

MANUAL OF WIRELESS TELEGRAPHY. By A. Frederick Collins. New York: John Wiley & Sons, 1906. 10 chapters; pp. 232; 90 illustrations; 1 chart. Price, $1.50.

This book combines theory and practice, and while instructive to the general reader, is intended more especially for the use of telegraph operators and engineers interested in wireless telegraphy. It is written in plain and simple words, and is for the most part free from mathematics and technical terms. It gives explicit instructions for the wiring of stations both ashore and on shipboard, and for the maintenance and arrangement of apparatus used in the principal systems. The author defines the attitude of the army and navy with reference to the employment of wireless telegraph operators, and outlines the nature of the work expected and the compensation therefor. A glossary of terms used in wireless telegraphy is included. The book contains little or no historical matter, and deals strictly with the present stage of development.

SWITCHBOARDS. By William Baxter, Jr. New York: The Derry-Collard Company, 1906. 8vo.; pp. 192. Price, $1.50.

This volume deals with switchboards for both direct and alternating current, and includes an excellent section on circuit-breakers. It is intended primarily for the use of engineers and others who have to do with switchboards in practice. The illustrations, both from photographs and diagram drawings, excellently supplement the text.

ANIMAL MICROLOGY. By Michael F. Guyer, Ph.D. Chicago: The University of Chicago Press, 1906. 12mo.; pp. 240. Price, $1.75 net.

Dr. Guyer's book will be found to be a valuable elementary treatise for the beginners in the study of microscopic science. It gives greater attention to the details of procedure than to the discriminations between reagents or the review of special processes. As the author explains, the book attempts to familiarize the student with the little "tricks" of technique which are commonly left out of books and methods, but which are of such great importance in securing good results. The Appendix includes a brief non-technical account of the principles of the microscope, as well as the formulæ for a number of the most widely-used reagents. A concise table of a large number of tissues and organs, with directions for preparing them properly for microscopic investigations, is also included. The Appendix concludes with valuable directions for collecting and preparing material for an elementary course in zoology.

MARINE ENGINEERS. By E. G. Constantine. 12mo.; pp. 332. Price, $2.

One purpose of the author of this book, as explained in the Preface, is an unusual one, namely, to furnish information to various classes of readers, including parents and guardians, who may have some intention of educating their sons to become engineers. Obscure technicalities have been carefully avoided and basic principles have been lightly dealt with, so as to indicate only the course best calculated to secure that acquisition of knowledge of the science of engineering and its branches which is the essential characteristic of the engineer.

AIR COMPRESSOR AND BLOWING ENGINES. By Charles H. Innes, M.A. London: The Technical Publishing Company, Ltd., 1906. 12mo.; pp. 290. Price, $2.

Compressed air has become of such great importance in engineering activity that the literature discussing and treating of the subject has grown to considerable proportions. Notwithstanding this, the book in question here will be welcomed by engineers interested in this phase of the profession. The text is a reprint of a series of articles which originally appeared in The Practical Engineer. The discussion includes the properties of air, calculations of the work necessary for compression under various circumstances, experiments with compressors, calculations of efficiencies, theories of valves for the equalization of pressure, construction of blowing engines, and descriptions of air compressors. The book is very fully illustrated.

DER NACHWEISS VON SCHRIFTFÄLSCHUNGEN, BLUT, SPERMA, U.S.W. By Prof. Dr. M. Dennstedt and Dr. F. Voigtländer. Braunschweig: Druck und Verlag von Friedrich Vieweg und Sohn, 1906. 12mo.; pp. 248.

It is unfortunate that at the present time there is in existence no translation of this extremely interesting and well-written German volume. It deals with the science of a certain phase of crime detection, and as is so often the case in the investigations of German experts, it is carried out with the greatest possible degree of accuracy and attention to detail. The illustrations, comprising mainly photographs of actual examples from German criminal records, are splendid. The book deals with the detection of forgeries, the recognition of blood stains, etc., and is treated in accordance with the rules of pure science, bringing into play very largely the use of photography.

THE COPPER HANDBOOK. A Manual of the Copper Industry of the World. Vol. VI. Houghton, Mich.: Compiled and published by Horace J. Stevens, 1906. 8vo.; pp. 1,116. Price, $5.

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Frame clamp, C. W. Lawson 840,777
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Garment hanger, C. B. Hotchkiss 840,625
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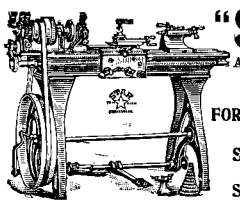

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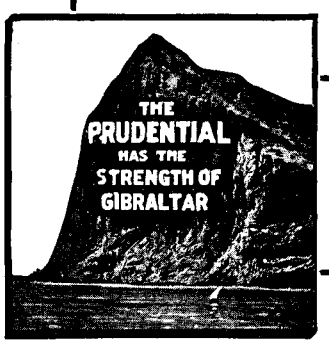

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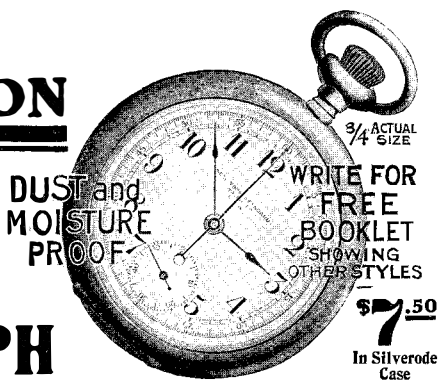

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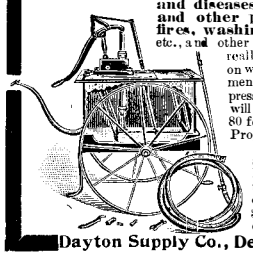

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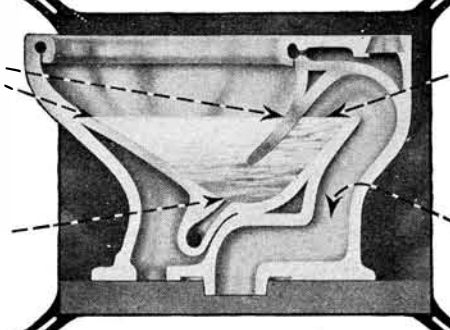
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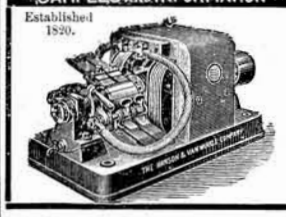

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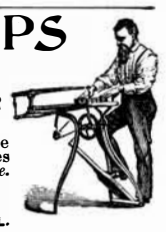

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